



Committee on Earth Observations Satellites

Consolidated Report 1992

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CEOS CONSOLIDATED REPORT

OVERVIEW

This report provides a concise overview of the Committee on Earth Observations Satellites (CEOS) and its Working Groups, covering the history and purpose of the Committee and its accomplishments to date. The Consolidated Report was prepared at the request of the CEOS membership in order to provide a background document for new and prospective CEOS members, as well as for other organizations or individuals with an interest in CEOS activities. The report will be updated annually before each Plenary meeting, and as developments in the Working Groups warrant.

The Committee on Earth Observations Satellites (originally named the International Earth Observations Satellite Committee, IEOSC) was created in 1984, in response to a recommendation from the Economic Summit of Industrialized Nations Working Group on Growth, Technology, and Employment's Panel of Experts on Satellite Remote Sensing. This group recognized the multidisciplinary nature of satellite Earth observations, and the value of coordinating across all proposed missions. Thus, CEOS combined the previously existing groups for Coordination on Ocean Remote-Sensing Satellites (CORSS) and Coordination on Land Remote-Sensing Satellites (CLRSS), and established a broad framework for coordination across all spaceborne Earth observations missions.

The first three CEOS Plenary meetings focused on creating and guiding the Working Groups deemed necessary to carry out the objectives of the CEOS members. After the third meeting, it was agreed that a more active orientation was required by the Plenary, and additional issues were brought before the group at the fourth meeting. At the fifth Plenary, international scientific programs and relevant intergovernmental organizations accepted invitations and participated as affiliate members of CEOS. This enabled progress toward integrating satellite data users' requirements into the CEOS process. Data exchange principles for global change research were also adopted. An interim CEOS Plenary meeting was held in April 1992, in preparation for the United Nations Conference on Environment and Development (UNCED). Brief encapsulations of the Plenary sessions immediately follow the Terms of Reference that govern the activities of CEOS as a whole; Terms of Reference for the individual Working Groups are included as Appendix A. A complete listing of CEOS members is offered as Appendix B.

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COMMITTEE ON EARTH OBSERVATIONS SATELLITES (CEOS)

CEOS TERMS OF REFERENCE

Preamble

Remote sensing from space has evolved from an early period of limited satellite programs to a point where distinctions among existing missions result from the technology employed, rather than from the disciplines served in system operations. In the future, a number of international and national spaceborne Earth observations systems will operate simultaneously and support both interdisciplinary and international activities.

The organization of international cooperation in spaceborne Earth observations systems also is evolving, from mission-specific reviews to the interdisciplinary coordination of multi-mission programs. Beginning with the first Multilateral Meeting on Remote Sensing held in Ottawa on May 8-9, 1980, which was attended by agency representatives from Canada, the European Space Agency (ESA), France, India, Japan, and the U.S., current and potential operators of Earth observations systems have met several times to discuss the means by which mutually beneficial cooperation and coordination could be achieved in both the near and longer term. As a result of these gatherings, the recent past has seen the creation of the Coordination on Land Observation Satellites (CLOS) by agency representatives from France, Japan, and the U.S. in Paris on November 13-14, 1980; the initiation of CORSS in Paris on May 10-11, 1982, through the efforts of agency representatives from ESA and Japan; and the second Multilateral Meeting on Remote Sensing, held in Paris on May 12-13, 1982, attended by agency representatives from France, Canada, ESA, India, Japan, and the U.S.

This framework of initial discussion and cooperation has enhanced the utility of spaceborne Earth observations data to users worldwide, has encouraged the coordination of program plans among spaceborne Earth observations system operators, and has fostered international receptivity to and acceptance of spaceborne Earth observations system activities and applications.

Consequently, the assembled representatives of international and national spaceborne Earth observations systems affirmed the following:

AWARE of the overlap of spaceborne Earth observations mission objectives and of the interdisciplinary applications of remotely sensed data, RECOGNIZING the advantages of ongoing communication and cooperation among spaceborne Earth observations system operators, and DESIRING to promote the international growth and potential benefits of spaceborne observations of the Earth, CEOS members have affirmed the value of the activities described above and have agreed to coordinate informally their current and planned systems for Earth observations from space through the organization of a Committee on Earth Observations Satellites (CEOS).

Cooperation in the development and management of remote-sensing and associated data management programs can be of benefit to operators of spaceborne Earth observations systems and to users of Earth observations data. Redundancy among systems and the utility of data can be optimized through the appropriate coordination of complementary and compatible space and ground segments, data management practices and products, and Earth observations systems research and development.

CEOS will not supersede current or potential agreements by members. Participation in the activities of CEOS will not be construed as being binding upon spaceborne Earth observations system operators, or as restricting their right to develop and manage Earth observations systems according to their needs.

Objectives

CEOS has three primary objectives:

- To optimize the benefits of spaceborne Earth observations through cooperation of its members in mission planning and in the development of compatible data products, formats, services, applications, and policies
- To aid both its members and the international user community by inter alia serving as the focal point for international coordination of space-related Earth observations activities, including those related to global change
- To exchange policy and technical information to encourage complementarity and compatibility among spaceborne Earth observations systems currently in service or development, and the data received from them; issues of common interest across the spectrum of Earth observations satellite missions will be addressed.

Individual members of CEOS will use their best efforts to implement CEOS recommendations in their respective Earth observations programs.

Participants

Members

Governmental organizations that are international or national in nature and are responsible for a civil spaceborne Earth observations program currently operating, or at least in Phase B or equivalent of system development, will be eligible for membership in CEOS. Members must have a continuing activity in spaceborne Earth observations, intended to operate and provide non-discriminatory and full access to data that will be made available to the international community. The addition of members will be with the consensus of current members of CEOS. Requests for membership should be addressed to the Chairperson of the next scheduled CEOS Plenary session. Such requests will be considered by the members at that meeting.

Observers

Governmental organizations that are international or national in nature and currently have a civil space-segment activity in Phase A/pre-Phase A or equivalent of system development, or a significant ground-segment activity that supports CEOS objectives, may be invited to participate through the status of observer. Addition of observers will be by consensus of existing members. Observers may participate in CEOS Plenary and Working Group discussions, and have their views included in reports; however, approval by observers will not be required to establish consensus.

Affiliates

CEOS will establish links to other existing satellite coordination groups and to scientific or governmental bodies that are international in nature and currently have a significant programmatic activity that supports CEOS objectives by inviting them to become formally affiliated with CEOS. Affiliates may participate, as appropriate, in the CEOS Plenary and Working Group meetings, and have their views included in reports; however, approval by affiliates will not be required to

establish consensus. The autonomy of both the affiliated organizations and the respective national and international Earth observations programs will remain intact. Membership in CEOS does not automatically assume membership in the respective affiliated organizations. Addition of affiliates will be by consensus of existing members.

Cooperative Activities

CEOS members will exchange technical information on and pursue the potential for coordination of space and ground segments. Such coordination could include discussions on current and future mission parameters, sensor capabilities and intercalibration, and data and telemetry downlink characteristics. In addition, Earth observations systems coordination within CEOS could address issues of ground station technical compatibility for backup satellite tracking, command and control, and sensor and telemetry data reception.

CEOS members will investigate the means for increasing data utility and cost-effectiveness, for both operators and users. CEOS activity could include the coordination of data acquisition, sampling, and pre-processing methodologies; the standardization of data formats where appropriate; the increase in compatibility of data archives; and the enhancement of user access to CEOS member databases, information products, and services. CEOS members will seek to ensure that the user community is made aware of the satellite programs of members and will encourage discussions between the users and the relevant satellite system operators, as necessary.

CEOS members will present their plans for emerging satellite remote-sensing technologies and programs, and will discuss appropriate approaches for the coordination of future systems. CEOS members will address current developments and future directions/opportunities in Earth observations from space, including free-flying spacecraft, mission-specific instruments flown on space transportation systems, and the placement of instruments on space platforms.

Organizations and Procedures

CEOS will convene once every year in Plenary session. Each member will designate a point-of-contact for coordination between meetings. CEOS meetings will be organized and chaired by the designated host organization. The designated host organization will provide secretariat services for the upcoming Plenary session, distribute minutes of that meeting, and report on any follow-on activities at the next Plenary session. At each meeting of CEOS, the time, place, and host for at least the next two meetings will be established. A list of members, affiliates, and observers and the dates they were accepted will be updated as appropriate, included as Appendix A to the Terms of Reference, and distributed with the minutes after each meeting.

CEOS also may establish, as mutually agreed and on an ad hoc basis, special temporary Working Groups to investigate specific areas of interest, cooperation, and coordination and to report at subsequent Plenary meetings. Continuation of each ad hoc Working Group requires confirmation at each Plenary session. Conclusions resulting from CEOS Plenary sessions, or the findings and recommendations of ad hoc Working Groups, will be acted upon at the discretion of each CEOS member.

CEOS may establish, as mutually agreed, standing Working Groups where an ad hoc status is deemed insufficient. More permanent status may be required to ensure long-term continuity of work in certain areas where the magnitude and complexity of the task is not suitable to short-term solutions. These standing Working Groups shall continue without requiring specific confirmation by the Plenary. The Chairpersons of such groups shall report at each CEOS Plenary session

on accomplishments and future plans. If the consensus of the Plenary is that such a group is no longer required, the Plenary may discontinue the group. In the absence of such a decision, however, the standing Working Group shall continue. Representatives from all CEOS members are invited to participate in all Working Groups.

CEOS will replace the Multilateral Meeting on Remote Sensing, CLOS, and CORSS. During the development of and action on CEOS activities, the member agencies of CEOS will follow the example of the successful international technical and programmatic cooperation achieved by the Coordination on Geostationary Meteorological Satellites. CEOS members also will consider the issues, concepts, and conclusions arrived at in previous gatherings of the Multilateral Meeting on Remote Sensing, CLOS, and CORSS, and will address current and future activities of spaceborne Earth observing systems.

CEOS will consider and may make recommendations and agree on actions to promote appropriate coordination across satellite coordination groups, and national and international satellite programs. Furthermore, CEOS encourages its members to maintain communication as appropriate with other groups and organizations involved in spaceborne Earth observations activities and applications through the relevant channels within their respective governments.

Adoption and Admendment

These Terms of Reference were adopted at the September 24-25, 1984, meeting of CEOS and were amended by consensus at the second meeting of CEOS, held at the European Space Research Institute (ESRIN) in Frascati, November 10-12, 1986. Additional amendments were made at the third meeting of CEOS in Ottawa, Canada, April 4-5, 1989, and at the fourth meeting in Sao Jose dos Campos, Brazil, November 13-14, 1990. They may be further amended by consensus of the members.

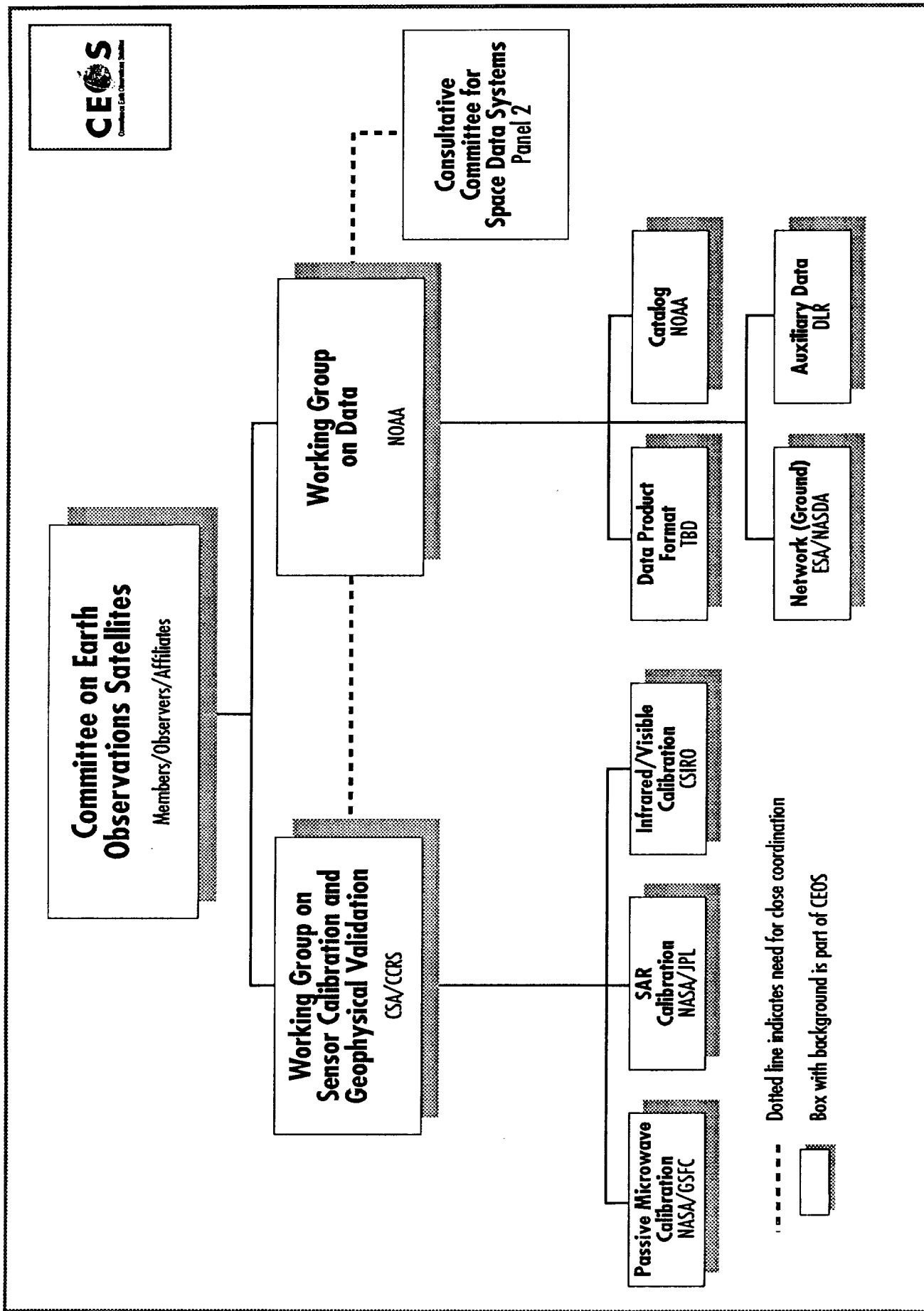
Adopted 9/25/84
Washington, DC

Amended 11/11/86
Frascati, Italy

Amended 4/5/89
Ottawa, Canada

Amended 11/14/90
Sao Jose dos Campos, Brazil

Reconfirmed 12/10/91
Washington, DC



CEOS WORKING GROUP STRUCTURE

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HIGHLIGHTS OF THE 1991 WASHINGTON, D.C., PLENARY MEETING

BRIEF CEOS HISTORY

- Expansion of CEOS membership to include the Swedish National Space Board, active participation of affiliates from the major international scientific and intergovernmental organization user bodies (i.e., ICSU, IGBP, IOC, WCRP, and WMO), and representatives from the State Meteorological Administration of the People's Republic of China attending as guests
- Adoption of the resolution on data exchange principles for global change/climate and environmental research and monitoring use
- Agreement to prepare a document describing the space and ground segments of CEOS members, measurements to be taken, launch dates, and user requirements integration
- Establishment of the Working Group on Sensor Calibration and Geophysical Validation (WGCV) as a standing working group, with Terms of Reference accepted
- Endorsement of Working Group on Data (WGD) accomplishments, and instruction to proceed with plans for CEOS IDN and coordination of requirements for the 1-km Advanced Very High-Resolution Radiometer (AVHRR) global land data set
- Agreement to send CEOS representatives to the GCOS Joint Scientific and Technical Committee, the WMO Executive Council Panel of Experts on Satellites, and the Space Agency Forum for the International Space Year (SAFISY)

Hosted by the National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA) in December 1991, the fifth Plenary meeting was marked by the inclusion of a new member and several new affiliates—the Swedish National Space Board for the former, and ICSU, IGBP, IOC, WCRP, and WMO for the latter. Affiliate status was awarded based on the need for enhanced involvement of international scientific programs and relevant intergovernmental user organizations. Such participation would enable progress toward integrating satellite data users' requirements into the CEOS process.

It was agreed that CEOS needed to document members' current and planned space and ground segment capabilities and the requirements of the international scientific community, enabling improved coordination of those capabilities and requirements. The British National Space Centre (BNSC) accepted the task of preparing a compendium of space- and ground-based assets of CEOS members and science user requirements. The resultant "CEOS Dossier of Satellite Missions and Global Environmental Programs" detailed the current status and plans for space missions, and how they related to major international environmental programs. That document served as the basis for the CEOS report presented at the UNCED meeting held in Rio de Janeiro on June 3-14, 1992. BNSC also accepted responsibility for generating the "CEOS Ground Segment Dossier," which will describe supporting ground system capabilities.

The Plenary also approved six principles relating to data exchange in support of global change/climate and environmental research and monitoring, as a first step toward adoption of a full set of principles covering other uses of data. Refer to the Data Exchange Principles section for details of this action.

Members also approved the new Terms of Reference for WGCV, establishing it as a standing working group and endorsing its recommendations. The WGCV chair—Canada—reported significant progress in organizing the group, forming contacts with other international groups, and coordinating calibration and validation activities.

The Plenary endorsed the work of WGD, and instructed it to move forward on accessing browse and digital quick-look data through CEOS IDN. WGD reaffirmed its intention to coordinate with IGBP and the implementing agencies in

development of requirements and specifications for the 1-km AVHRR global land data set. The Plenary also decided to make the ad hoc Working Group on Space-to-Ground Networks (WGSN) a subgroup under the purview of WGD.

In response to numerous invitations, CEOS members consented to send representatives to meetings of international scientific and intergovernmental user organizations. The Plenary resolved to take a leading role in providing scientific and technical guidance for the space research components of GCOS, and to provide names of three candidates to serve on the GCOS Joint Scientific and Technical Committee. The Plenary also agreed to send CEOS representatives to the WMO Executive Council Panel of Experts on Satellites and to SAFISY.

HIGHLIGHTS OF THE 1992 LONDON INTERIM PLENARY MEETING

On April 28-29, 1992, CEOS members met in London with senior national and regional environmental officials from Australia, Brazil, Canada, China, Europe [Commission of European Communities (CEC), European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), and European Space Agency (ESA)], France, Germany, India, Italy, Japan, New Zealand, Norway, Russia, Sweden, the United Kingdom, and the United States. Also participating in this interim CEOS Plenary meeting were senior officials from the Intergovernmental Oceanographic Commission (IOC), International Council of Scientific Unions (ICSU), United Nations Environment Program (UNEP), and World Meteorological Organization (WMO), as well as the chief international scientific programs they support [i.e., Global Climate Observing System (GCOS), International Geosphere-Biosphere Program (IGBP), and World Climate Research Program (WCRP)]. The group met at the invitation of former U.K. Minister of the Environment (now Minister of Trade and Industry) David Heseltine, to pursue an initiative proposed by Prime Minister Major. This initiative sought the following:

- Bring attention to current and planned Earth observations satellite missions
- Strengthen coordination among satellite missions in the areas of data handling, processing, archiving, and networking
- Further dialogue between space agencies and environmental users.

On April 28, CEOS members met to finalize a dossier on the full array of satellite Earth observations missions for the next decade. In a concurrent meeting, senior environmental officials discussed how these satellite missions might be of assistance to environmental data needs for research, monitoring, resource assessment, and other uses. They were particularly interested in mechanisms (including the CEOS affiliate process) through which environmental user requirements could be discussed with satellite data-providing agencies.

The joint meeting of CEOS and environmental officials resulted in an initiative aimed at improving dialogue among the space agencies and environmental users, and increasing the use of satellite data to support the environmental information needs of national and international environmental programs. The initiative included five elements:

- 1) **Recognize, encourage, and support the work of CEOS in providing a forum for international coordination on satellite missions, calibration and validation of data, data policy on networking and international data exchange, and space data provider and user communications**—The avenue of communication CEOS provides to other appropriate international organizations, in particular GCOS and the Global Oceanographic Observing System (GOOS), was lauded; the fact that CEOS activities in no sense inhibit national mechanisms for setting priorities or carrying out domestically funded missions was recognized; and the importance of the satellite mission dossier currently being prepared by CEOS was underscored.

- 2) **Encourage and facilitate the provision of information on satellite missions and data to national and international environmental programs**—The meeting participants welcomed both the satellite mission dossier (with additional sections on the ground segment) and the International Directory Network (IDN), which is coordinated by CEOS and allows users to determine how data can be obtained.
- 3) **Urge and encourage national and international environmental programs to formulate data needs and priorities**—A possible mechanism could be closer coordination among environmental space data users as a group. The meeting participants recommended that the programs establish their priorities as quickly as possible, while recognizing that national requirements for environmental data should be fed into relevant space agencies using existing national mechanisms.
- 4) **Encourage the efforts of countries and international environmental programs that are currently developing the potential to contribute to Earth observation satellite programs and to the processing and analysis of data**—The meeting participants noted with approval many programs and initiatives aimed at providing assistance to new users, particularly in developing countries. The role of the United Nations, international scientific organizations, and the environmental programs they support was seen as particularly important in the development of a satellite data users' voice and as the conduit for the requirements of developing countries.
- 5) **Make the efforts of CEOS better known within the user community, and foster the widest use of satellite data**—As a first step, a statement of relevant existing and planned satellite missions (drawn from the CEOS dossier) was made available to delegates at the United Nations Conference on Environment and Development (UNCED). It was agreed that the individual countries represented at the meeting could use the conclusions of the London CEOS meeting as they saw fit in their UNCED country statements.

Finally, all participants were encouraged to pursue the objectives of the above initiative to the fullest extent possible, within available resources. The CEOS affiliates made plans to meet to bring together environmental user needs, which will serve as the basis for further discussion with the CEOS members at the December 1992 Plenary meeting.

HIGHLIGHTS OF THE 1990 SAO JOSE DOS CAMPOS PLENARY MEETING

- Rededication of CEOS Plenary through focus on unique CEOS role representing Earth observation system operators, and enhanced outreach to international scientific, policy, and intergovernmental groups
- Modification of Terms of Reference regarding commitment to provide non-discriminatory and full access to data, and proposal from U.S. to establish data exchange principles for global change research
- Creation of Working Group on Space-to-Ground Networks (WGSN), with Japan as chair
- Chairmanship of WGSN transferred to the Canada Centre for Remote Sensing (CCRS)

The fourth CEOS Plenary meeting, hosted by Instituto Nacional de Pesquisas Espaciais (INPE), was the start of the revitalization of the CEOS Plenary as a forum for programmatic and policy discussions among satellite operators, and between space segment operators and the international user community. Members felt that the CEOS organization had demonstrated its utility and stability, and renewed their commitment to avoid the proliferation of coordination mechanisms by directing issues and requirements related to Earth observations to the CEOS forum as the focal point for such matters. Members agreed that CEOS should invite international user groups to affiliate themselves with CEOS and to participate in future Plenary meetings. This would provide a mechanism for such groups to propose requirements to CEOS.

NASA and NOAA presented a set of data exchange principles for global change research, based on an effort within the U.S. to develop a national policy for global change data management, and proposed that CEOS endorse a similar set of policy principles. CEOS members agreed to participate in a dedicated meeting on data policy organized by BNSC to discuss this proposal. Details of this meeting are provided in the Data Exchange Principles section.

The WGD report was received and endorsed. WGD recommended establishment of the ad hoc WGSN to address space-to-space and space-to-ground network requirements and coordination in support of CEOS programs. Japan offered to host the first meeting of this group and report back at the next Plenary meeting.

Canada offered to chair WGCV, and defined a set of six tasks for that group.

The CEOS Secretariat agreed to send information on CEOS to organizations in the Soviet Union and the Peoples Republic of China, both of which might be eligible to join CEOS as members. If an agency wishes to request membership, the request would be considered at the next Plenary meeting.

HIGHLIGHTS OF THE 1988 OTTAWA PLENARY MEETING

- Consolidation of Earth observations satellite coordination groups through termination of the International Forum for Earth Observations using Space Station Elements (IFEOS) and transfer of remaining functions to CEOS
- Expansion of CEOS membership to include Australia and EUMETSAT, with the European Community (EC) and New Zealand invited to become observers
- WGD established as a permanent rather than ad hoc group, with appropriate modification of Terms of Reference; direction for future should emphasize polar platform, networking, and random access media
- Importance of revitalized calibration/validation coordination emphasized
- Observer status created for CEOS to ensure opportunities for participation by all potential contributors

The third CEOS Plenary meeting was conducted in conjunction with the concluding meeting of IFEOS. IFEOS was formed to ensure that the proposed Space Station polar platforms were devoted to Earth observations; that mission having been completed, the group was dissolved by unanimous agreement. However, since there were several members of IFEOS with active Earth observations programs who were not also members of CEOS, and there was agreement that no agency should be disenfranchised from the coordination process, the CEOS Terms of Reference were modified to provide for continued participation through CEOS. As a result, EUMETSAT and Australia requested membership and were accepted, and the EC and New Zealand, neither of whom were present, were invited to request observer status.

The major outcome of the third Plenary was the acceptance of a proposal by WGD to change its status from ad hoc to permanent to ensure that there would be continuity and stability in data management coordination. The progress of work to date was reviewed and endorsed, and direction given for the future. Plenary members requested WGD to concentrate on polar platform data management issues, networking, and data formats for random access media, and to report back at the next Plenary meeting. The relative inactivity of WGCV was also discussed, with ESA offering to turn over chairmanship to another agency. Useful discussion took place over the role of WGCV and the importance of including non-space organizations in the process.

HIGHLIGHTS OF THE 1986 FRASCATI PLENARY MEETING

- CEOS membership expanded to include U.K., Germany, and Italy
- Sharing of satellite failure analysis reports
- Approval of continuation of WGD as standing body able to serve as control authority for data formats
- Approved use of WGD as focal point for polar platform data management coordination; urged coordination with Consultative Committee on Space Data Systems (CCSDS)
- Approved continued work of WGCV with direction to include non-CEOS agencies with relevant expertise and resources
- Endorsed International Space Year (ISY)

The second CEOS Plenary meeting was hosted by ESA in Frascati, Italy, in November 1986. At this meeting, membership was expanded to include key European countries with significant space-based Earth observations activities that are implemented through international cooperation. The Plenary members reviewed the initial work of the two ad hoc Working Groups. For WGD, CEOS members considered the relationship with CCSDS and the role of CEOS with respect to the anticipated polar platforms of the Space Station Program. WGD was given the status of a standing body in order to be able to serve as a "control authority" with respect to digital data formats for Earth observations data. In addition, CEOS WGD was given the responsibility for addressing polar platform data management issues at the request of the parties involved in the polar platforms. Specifically, the Earth Observations International Coordination Working Group (EO-ICWG) decided not to create its own data management subgroup, but to use CEOS WGD instead.

With respect to WGCV, the report of the first year's activity was accepted, and the Chairperson was directed to invite organizations with non-space resources to work together with space agencies to ensure well-coordinated support to scientific research projects.

Members exchanged information on their current activities, including space systems, data systems, and training. CEOS agreed to generate and maintain a list of international meetings of interest to CEOS members. CEOS was invited to participate in meetings of CCSDS. A resolution endorsing ISY also was passed. The CEOS Terms of Reference were reviewed and amended to reflect the new membership and clarification of certain items.

HIGHLIGHTS OF THE 1984 WASHINGTON, D.C., PLENARY MEETING

- Group formed and Terms of Reference adopted
- Focus on all Earth observations missions regardless of "disciplinary" focus (e.g., oceans, land, etc.)
- Emphasis on service to users (i.e., data, training, information dissemination)
- Ad hoc Working Groups created on Data (WGD) and on Calibration and Validation (WGCV)

The first CEOS Plenary meeting was hosted by NOAA in Washington, DC, on September 24-25, 1984. Attendees represented the Centre National d'Etudes Spatiales (CNES), Indian Space Research Organization (ISRO), National Space Development Agency (NASDA), CCRS, ESA, INPE, NOAA, and NASA, with observers from other U.S. agencies. The participants approved Terms of Reference and created ad hoc Working Groups on Data and on Calibration and Validation. This meeting was the first opportunity for all the participants to exchange information on their Earth observations satellite programs and plans in a multilateral, multidisciplinary forum. One item of particular interest was the importance of user outreach and training. It was agreed that members should exchange information about user meetings.

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1991 HIGHLIGHTS

DATA EXCHANGE PRINCIPLES

BNSC hosted a CEOS meeting on data exchange principles in Abingdon on April 4-5, 1991. The purpose of the meeting was to consider the draft data exchange policy resolution presented at the November 1990 Plenary, aiming to establish general principles covering satellite data policy and to consider specifically the question of data exchange. The results of the Abingdon meeting were presented at the 1991 Plenary, and resulted in the following data exchange principles endorsed by the entire CEOS Plenary:

RECOGNIZING that the members of CEOS are actively involved in supporting global change/climate and environmental research and monitoring efforts of the international scientific community, as well as pursuing other uses of Earth observations data such as local/regional research, operational environmental monitoring, and commercial

AWARE that success in global change/climate and environmental research and monitoring requires a continuing commitment to the establishment, maintenance, validation, description, accessibility, and distribution of high-quality long-term data sets, many of which rely on spaceborne observations

ANTICIPATING the potential benefits of compatible policies and mechanisms for data exchange in obtaining access to global data

CEOS members endorse the following principles relating to data exchange in support of global change/climate and environmental research and agree to work toward implementing them to the fullest extent possible. Principles for data exchange in support of other data uses beyond global change/climate and environmental research will be developed for CEOS endorsement as a next step.

- 1) Preservation of all data needed for long-term global change/climate and environmental research and monitoring is required.
- 2) Data archives should include easily accessible information about the data holdings, including quality assessments, supporting ancillary information, and guidance and aids for locating and obtaining the data.
- 3) International standards, including those generated by the CEOS Working Group on Data, should be used to the greatest extent possible for recording/storage media and for processing and communication of data sets.
- 4) Maximizing the use of satellite data is a fundamental objective. An exchange/sharing mechanism among CEOS members is an essential first step to maximize use.
- 5) Programs should have no exclusive period of data use. Where the need to provide validated data is recognized, any initial period of exclusive data use should be limited and explicitly defined. The goal should be release of data in some preliminary form within 3 months after the start of routine data acquisition.
- 6) Criteria and priorities for data acquisition, archiving, and purging should be harmonized.

REPORT OF THE 1992 AD HOC DATA POLICY MEETING

In anticipation of the sixth CEOS Plenary meeting to be held in London on December 9-11, 1992, an ad hoc CEOS data policy meeting was convened in Paris on October 28-29, 1992, upon the invitation of the Centre National d'Etudes

Spatiales (CNES). The meeting participants agreed upon five recommendations to be presented in London. The proposed items are in bold below, with the specific recommendations to the Plenary underlined:

- **Draft amendments to the Resolution on Data Exchange Principles adopted at the 1991 Plenary meeting have been developed. The Plenary is invited to endorse this Resolution on Satellite Data Exchange Principles in support of Global Change Research in place of the 1991 resolution. Differences between the 1991 and 1992 resolutions have been earmarked by italics.**

RECOGNIZING that the members of CEOS are actively involved in supporting global change/climate and environmental research and monitoring efforts of the international scientific community, as well as pursuing other uses of Earth observations data such as local/regional research, operational environmental monitoring, and commercial

RECOGNIZING the investments made by governments and international agencies in support of global change/climate research and environmental research and monitoring and the value of non-satellite data to these programs

TAKING INTO ACCOUNT that the acquisition, processing, and supply of data (especially space data) involve major investments, and that data have value

RECOGNIZING that these investments and values should be respected by data suppliers and users

RECOGNIZING the existence of various policy aims such as maximizing the use of data from all sources and shifting the funding responsibility for certain remote-sensing systems to users or other sources

AWARE that success in global change/climate and environmental research and monitoring requires a continuing commitment to the establishment, maintenance, validation, description, accessibility, and distribution of high-quality long-term data sets, many of which rely on spaceborne observations

ANTICIPATING the potential benefits of compatible policies and mechanisms for data exchange in obtaining access to global data

REAFFIRMING the commitment of CEOS members to the general principle of non-discriminatory access to data

RECOGNIZING the importance of appropriate legal regimes for the exchange of remotely sensed data

CEOS members endorse the following principles relating to satellite data exchange in support of global change/climate and environmental research *and monitoring* and agree to work toward implementing them to the fullest extent possible. Principles for data exchange in support of other data uses beyond global change/climate and environmental research *and monitoring* will be developed for CEOS endorsement as a next step.

- 1) Preservation of all data needed for long-term global change/climate and environmental research and monitoring is required.
- 2) Data archives should include easily accessible information about the data holdings, including quality assessments, supporting ancillary information, and guidance and aids for locating and obtaining the data.
- 3) International standards, including those generated by the CEOS Working Group on Data, should be used to the greatest extent possible for recording/storage media and for processing and communication of data sets.
- 4) Maximizing the use of satellite data is a fundamental objective. An exchange/sharing mechanism among CEOS members is an essential first step to maximize use.
- 5) *Non-discriminatory access to satellite data by non-CEOS members for global change/climate and environmental research and monitoring is essential. This should be achieved within the framework of the exchange and sharing mechanisms set up by CEOS members.*

- 6) Programs should have no exclusive period of data use. Where the need to provide validated data is recognized, any initial period of exclusive data use should be limited and explicitly defined. The goal should be release of data in some preliminary form within 3 months after the start of routine data acquisition.
 - 7) Criteria and priorities for data acquisition, archiving and purging should be harmonized.
- **First steps should be taken to put the above-mentioned principles into implementation. The Plenary is invited to consider the following specific recommendations adopted to this end by the Paris meeting participants.**
 - **The general mechanisms for the execution of CEOS Data Exchange Principles 1, 2, 3, and 7 follow. Though recognizing that the implementation of these recommendations may require significant investment, the Paris meeting participants agreed to propose to the Plenary that it adopt these recommendations.**
 - 1&7) In coordination with ad hoc committees of the various relevant international programs (e.g., IGBP, WCRP, GCOS, GOOS, UNEP), CEOS members should define and disseminate data management plans addressing where and how long-term global change data are being acquired and preserved, and the procedures and criteria for continued data acquisition, retention, and purging. The objective is to establish an informal "clearinghouse" function through CEOS for satellite-based observations, coordinated with other relevant data management organizations to optimize the collective development and maintenance of critical data and information. Before a CEOS member purges a data set, other CEOS members should be notified to see if the data set is of interest and whether it could be maintained by another custodian. Through the IDN effort overseen by CEOS WGD, regular updates will be easily accessible concerning data acquisition. The CEOS Plenary should direct WGD to define a process for providing a compilation and integration of data management plans in a broader context through WGD.
 - 2) Through the CEOS WGD Catalog Subgroup (CS), standards have been proposed for what information needs to be included in a directory. The Directory Interchange Format (DIF) defines the minimum content and format for such information, and the prototype international directory is already in place to permit agencies and users to use and evaluate the system. WGD should be encouraged to continue its work and address guide- and inventory-level standards and interconnectivity as well. The existence of all data sets should be documented on international directory networks.
 - 3) The "CEOS Consolidated Report" will summarize the recommendations to date regarding data product format standards, catalog systems, and other areas. In addition, other organizations (e.g., CCSDS) are conducting work on standards that should be taken into account. In order to facilitate international exchange of data and integration of data from multiple sources, use of standards will be extremely important. CEOS members should seek to agree on common standards that meet their programmatic requirements, and should commit to offering data and products in agreed CEOS standards where such exist.
 - **Most of the discussion in Paris concentrated on the implementation of Principle 4, and the exchange/sharing mechanism(s) that should be established among CEOS members to maximize the use of satellite data for global change research. The Paris meeting participants acknowledge that there are already large areas of agreement, with respect to the objectives,**

the identification of data sets, the selection of users, and the need for written agreements to be signed by the selected users. Namely, the Plenary could endorse the following approach:

- Catalog of available standard data—Each data provider (normally a CEOS member) will provide a catalog of the standard products available for each system, and include such information in the CEOS IDN.
 - Identification of data sets—Data requirements should be identified by ad hoc committees of the various international research programs related to global change (e.g., WCRP, IGBP) on the basis of their priorities and against criteria of key needs and/or continuing core measurement requirements. These requirements should be coordinated among relevant programs in forums such as the workshop planned for the 1992 CEOS Plenary. Data sets should be selected from among the standard products as defined by the data providers and within volumes compatible with their capabilities and their available resources. These data sets may originate from any system or instrument, whether experimental, operational, or commercial.
 - Selection of global change researchers—Global change researchers will be chosen through selection procedures, such as research announcements with a peer review or a similar process. These selections will be made at a national level or under cooperative intergovernmental programs, within the context and framework of the research priorities of the recognized international or national global change programs. Review teams should be open to international participation. The selection procedures should be designed in such a way as to be able to integrate new research teams on short notice. Particular emphasis should be placed on encouraging participation from developing countries and other non-CEOS participants.
 - Written agreements—Jointly with their institution, selected global change researchers should formally sign a written agreement, including prohibition on redistribution and commercial use if required by the data provider, and a requirement for publication of all results and methods in the established scientific literature.
 - Sharing of data among selected users—All data provided through these mechanisms also will be available to other selected global change researchers, as well as the original recipients.
- The Paris meeting participants also recognized that there is a common goal of providing data to global change researchers on a consistent basis (i.e., the cost of filling the user request) from all missions within the constraints of the systems and available resources, although different mechanisms for data exchange/sharing may be found for different programs. In particular, a large discussion took place on a proposal prepared by a subgroup consisting of ESA, European members of ESA, and Canadian representatives, which advanced the concept of a “data pool.” This pool would not materialize in any such form as a data bank, but rather would consist in an identifiable set of data products (i.e., data flagged in a catalog) being held at the most appropriate site. This pool would provide those data (e.g., commercial data) that CEOS members could not distribute normally at the “cost of filling the user request” and for which they would pursue efforts for getting the “lowest possible cost.” CEOS members could implement funding schemes, possibly involving other organizations, for the purchase of these data, then provide it to the global change researcher at the cost of filling the user request. The group recognized that such new mechanisms would need to be explored through pilot project(s). The Plenary is invited to recommend that such a pilot project be initiated, among proposals to be sought from the IGBP Data and Information System (IGBP/DIS), and managed by a task force led by the CEOS Secretariat. To be representative, this pilot project should involve high-resolution as well as other types of data, and combine data from space programs managed by Europe, Japan, and North America.

In June 1992, the current CEOS chair—Mr. Arthur Pryor/British National Space Centre (BNSC)—sent a letter to all CEOS members, which addressed the ever-increasing administrative requirements levied by CEOS. In this letter, he suggested formation of a task force to examine options for a more permanent secretariat. Dr. Burkhard Pfeiffer/European Space Agency (ESA) organized the task force, and its report was distributed before the 1992 Plenary. Action will be taken on its recommendations for a permanent CEOS Secretariat at the December 1992 Plenary meeting.

CEOS SECRETARIAT

The report indicated that the burden associated with CEOS administration was indeed growing at an alarming rate and that there was a requirement to provide consistency and continuity in CEOS deliberations. To address these issues, the task force recommended that secretariat functions be consolidated, with the resources to support this effort divided in a manner that has yet to be determined. The report proposed that the CEOS Secretariat be composed of participants from ESA, the National Aeronautics and Space Administration/the National Oceanic and Atmospheric Administration (NASA/NOAA), and the Science and Technology Agency/National Space Development Agency (STA/NASDA)—serving in liaison capacities with CEOS members in Europe, the Americas, and Asia, respectively, along with the incoming CEOS Plenary host agency. Chairpersons of the CEOS Working Groups would be included as observers in all secretariat activities.

The report proposed an allocation of tasks among the secretariat members, and included an amendment to the CEOS Terms of Reference and Terms of Reference for the CEOS Secretariat itself. If adopted at the sixth Plenary, the CEOS Secretariat could begin work in early 1993.

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This section lists space- and ground-based assets included within the scope of CEOS activities. Some of the cooperative arrangements associated with these programs resulted from information exchanged under CEOS auspices. In all cases, an effort is being made to use the recommendations of the CEOS Working Group on Data (WGD) and Working Group on Sensor Calibration and Geophysical Validation (WGCV) where appropriate for data exchange formats and calibration and validation activities.

Complete details on these programs are available in the "CEOS Dossier of Satellite Missions and Global Environmental Programs" and the "CEOS Dossier on Ground Segments," which can be obtained from the British National Space Center (BNSC). Refer to Appendix E for a complete listing of the acronyms.

FLIGHT AND GROUND SEGMENT PROGRAMS

Instituto Nacional de Pesquisas Espaciais (Brazil)

- MECB
 - Data Collecting Satellite-1 – 1992
 - Data Collecting Satellite-2 – 1993
 - Remote Sensing Satellite-1 – 1994
 - Remote Sensing Satellite-2 – 1995
- CBERS-1 – 1994 (with China)
- CBERS-2 – 1995 (with China)

Canadian Space Agency

- Radarsat – 1995
- Radarsat follow-on – TBD
- EOS-AM (MOPITT instrument) – 1998 (with NASA)
- NOAA-9 through -12 and -1 through -Q (Argos, Search and Rescue instruments) – Present through 2010 (with CNES and NOAA)
- POEM-METOP (Argos, Search and Rescue instruments) – 2000 (with CNES, ESA, EUMETSAT, and NOAA)

European Organisation for the Exploitation of Meteorological Satellites

- Meteosat-3 through (-8) – 1988 (with ESA), 1989, 1991, 1993, 1995, (1997)
- MSG1 – 1999 (with ESA)
- NOAA-N (AMSU-B instrument) – 2000 (with NOAA)
- POEM-METOP – 2000 (with ESA, CSA, CNES, and NOAA)
- POEM-METOP2 – 2005 (with ESA and NOAA)

European Space Agency

- ERS-1 – July 1991 (with BNSC and CNES)
- EARTHNET – Ongoing
- ERS-2 – April 1994
- ARISTOTELES – 1998
- POEM-ENVISAT – 1998 (with BNSC, CNES, and DARA)
- DRS – 1998
- POEM-METOP – 2000 (with EUMETSAT, CNES, CSA, and NOAA)

Centre National d'Etudes Spatiales (France)

- SPOT-1 and -2 – 1986, 1990
- NOAA-9 through -12 and -1 through -Q (Argos, Search and Rescue instruments) – Present through 2010 (with CSA and NOAA)
- ERS-1 – July 1991 (with BNSC and ESA)
- TOPEX/Poseidon – August 1992 (with NASA)
- SPOT-3 – 1993
- SCARAB/Meteor – 1993, 1994 (with DARA and CIS)
- ADEOS (POLDER instrument) – 1996 (with STA/NASDA and NASA)
- SPOT-4 – 1996
- POEM-ENVISAT – 1998 (with BNSC, ESA, and DARA)
- POEM-METOP (Argos, Search and Rescue instruments) – 2000 (with CSA, ESA, EUMETSAT, and NOAA)
- SPOT-5 – 1999, RADAR – 2000
- BEST – 2000

Deutsche Agentur für Raumfahrtangelegenheiten (Germany)

- X-SAR on SIR-C Series – 1992, 1993, 1995 (with NASA and ASI)
- SCARAB/Meteor – 1993, 1994 (with CNES and CIS)
- MOS/PRIRODA – 1993 (with Russian Academy of Sciences)
- POEM Series – 1998

Indian Space Research Organization

- IRS-1a – March 1988
- IRS-1b – August 1991
- INSAT-IIa – 1992
- IRS-1e – 1992
- INSAT-IIb – 1993
- IRSP-2 – 1993
- IRS1-c – 1993-94
- INSAT-IIc – 1994
- INSAT-IId – 1995
- IRS-1d – 1996-7
- IRSP-3 – TBD

Agenzia Spaziale Italiano (Italy)

- LAGEOS-2 – October 1992 (with NASA)
- LAGEOS-3 – 1995
- POEM Series – 1998

Science and Technology Agency/National Space Development Agency (Japan)

- GMS-4 – September 1989
- MOS-1b – February 1990
- JERS-1 – February 1992

- GMS-5 – 1994
- ADEOS – 1996 (with CNES and NASA)
- ADEOS Data System – 1996
- TRMM – 1997 (with NASA)
- EOS Series – 1998 (with NASA, CSA, ESA, and EUMETSAT)
- ADEOS-2 – 1999
- TRMM-2 – TBD

British National Space Centre (United Kingdom)

- UARS – September 1991 (with NASA)
- NOAA-I through -M (AMSU-B instrument) – 1993, 1994, 1996, 1997, 1999
- ERS-1 (ATSR instrument) – July 1991
- ERS-2 (ATSR instrument) – April 1994
- POEM Series – 1998

National Aeronautics and Space Administration (United States)

- SSBUV – Present through 1996
- ATLAS – 1992 through 1996 (with Europe and Japan)
- TDRSS – Ongoing
- TOMS/Meteor – August 1991
- UARS – September 1991 (with U.K.)
- LAGEOS-2 – October 1992 (with ASI)
- TOPEX/Poseidon – August 1992 (with CNES)
- SIR-C – June 1992, 1993, 1995
- TOMS/Scout – 1993
- SeaWiFS (data purchase) – August 1993
- TOMS/Earth Probe – December 1993, 1997
- EOS Data and Information System (EOSDIS) – Ongoing
- ADEOS (NSCAT and TOMS instruments) – 1996 (with STA/NASDA and CNES)
- TRMM – 1997 (with STA/NASDA)
- EOS-AM – 1998 (with ESA, CSA, and STA/NASDA)
- EOS-COLOR (follow-on to SeaWiFS) – 1998
- Landsat-7 – 1998
- EOS-AERO – 2000
- EOS-PM – 2000 (with ESA and EUMETSAT)
- EOS-ALT – 2002 (with CNES)
- EOS-CHEM – 2002

National Oceanic and Atmospheric Administration (United States)

- NOAA-9 through -12 – December 1984, September 1986, September 1988, May 1991
- Landsat-4 and -5 – July 1982, March 1984
- GOES 7 – February 1987
- NOAA-I – 1993
- Landsat-6 – 1993

- GOES-I – 1994
- NOAA-J – 1994
- GOES-J – 1995
- NOAA-K – 1996
- NOAA-L – 1997
- POEM-METOP – 2000 (with CSA, CNES, ESA, and EUMETSAT)
- GOES-K – 1999
- NOAA-M – 1999
- GOES-L – 2000
- NOAA-N – 2000 (with EUMETSAT)
- NOAA-N' – 2002 (with CNES, CSA, and EUMETSAT)
- NOAA-O – 2004
- GOES-M – 2004
- NOAA-P – 2007
- NOAA-Q – 2010
- Future EOS – TBD

The CEOS Working Group on Data (WGD), chaired by the National Oceanic and Atmospheric Administration (NOAA), was established at the first Plenary meeting as an ad hoc Working Group in accordance with the CEOS Terms of Reference. Meetings have been held once to twice per year since 1984, with the thirteenth meeting occurring in October 1992. WGD was made a permanent working group in 1989. CEOS WGD met three times since November 1991, and there have been 10 meetings of the various WGD subgroups during 1992. The overall WGD and individual subgroup Terms of Reference are included in Appendix A; the current WGD points-of-contact are listed in Appendix C.

WORKING GROUP ON DATA

Summary and Objectives

The WGD goal is to facilitate the use of data from Earth observations missions for the benefit of CEOS members and the international user community by coordinating and standardizing aspects of data management. WGD recognizes the need to support global change research and environmental monitoring projects, and to coordinate with other international groups. In particular, WGD provides technical support to the Earth Observations International Coordination Working Group (EO-ICWG) in data-related matters concerning the International Earth Observing System (IEOS). The highlights of WGD accomplishments and relevant background information are offered below. Full details are available from NOAA through the CEOS WGD Library, and in the reports from each WGD meeting.

Accomplishments

Catalog Systems

At WGD-4 in February 1988, a Catalog Subgroup (CS) was formed. Chaired by NOAA, the goal of CS is to promote international catalog system interoperability. Such a system allows users to determine what data of interest exist, how they can be obtained, and how other information supporting the utilization of the data can be acquired. The CS document entitled "Guidelines for an Internationally Interoperable Catalog System" prepared under the leadership of the British National Space Centre (BNSC) is intended to provide a single reference source for the results of CS discussions. The draft document will be completed by early 1993, and widely distributed soon thereafter.

The CEOS International Directory Network (IDN) is now fully operational, with several new Cooperating Nodes. Because of its success and visibility, CEOS IDN has the potential to influence directory development of CEOS and non-CEOS members. The current CEOS IDN structure is included in Appendix D. IDN allows a user to determine how the data (along with ancillary supporting information) can be obtained. The IDN listings include both satellite and in situ data sets, and append data set descriptions based on a Directory Interchange Format (DIF)—a standardized format for exchange between data set directories. Typically, interconnections allow the user to connect from a Coordinating Node to other on-line data and information systems that give more detail about the data. Users can access IDN at no cost, using network systems such as Internet and the National Aeronautics and Space Administration (NASA) Science Internet, or through dial-in telephone lines. The Canada Centre for Remote Sensing (CCRS) has developed several mock-ups of an IDN brochure, which WGD plans to publish.

At CS-8 in February 1992, work began on a multi-agency, international Level III Catalog Interoperability Experiment (CINTEX) to determine if disparate catalog systems (i.e., designed under different sets of requirements and initial conditions) could be made to interoperate effectively. The goal is to produce a report in late 1993, evaluating the possibility of an operational system. Also at CS-8, an Advanced Very High-Resolution Radiometer (AVHRR) Inventory Exchange Format (IEF) was completed as part of the CS initiative toward development of an end-to-end international,

interoperable data management system for AVHRR data. This format will be used for the exchange and collection of information on AVHRR receiving stations. A new activity of interest involves development of an AVHRR browse exchange.

Data Formats

A primary goal of WGD is to develop and support standard data formats for digital user products from all Earth observations sensors. Specifically, there should be a common family of formats using the same approach for all sensors. CEOS has adopted the Landsat Technical Working Group (LTWG) superstructure—now called the “CEOS/LTWG Superstructure”—as the basis for this format family. The same approach was adopted for magnetic tape and optical storage media. Within this family, specific implementations are developed for classes of sensors (e.g., synthetic aperture radars, visible and near-infrared imagers, or scatterometers). The objective is to permit users to ingest and analyze data from similar instruments on more than one mission without extensive data format conversions, and to move from one type of instrument to another without major changes in approach.

CEOS formats may be offered by data centers as the only standard, or may be available as one of several options. Recommended formats have been evaluated and endorsed by WGD as being in full compliance with the CEOS Superstructure (i.e., meeting CEOS documentation requirements), and are advocated by the agency responsible for sensor development.

The original CEOS format approach was based on Landsat instrument formats. The CEOS formats that have evolved have been implemented for data products which include:

- **SAR computer-compatible tape (CCT)**—Implemented by the European Space Agency (ESA) for the European Remote Sensing Satellite-1 (ERS-1) and Japan for the Japanese Earth Resources Satellite-1 (JERS-1), and to be implemented by NASA for the Spaceborne Imaging Radar-C (SIR-C) and the Canadian Space Agency (CSA) for Radarsat
- **Visible/infrared imagers**—AVHRR Level 1b products, and ERS-1 Along-Track Scanning Radiometer (ATSR) and Microwave Radiometer (MWR) data (as of April 1992).

The full list of approved formats is given in Appendix D.

The WGD Format Subgroup (FS) has addressed standardization of specific CEOS format implementations for the distribution and archival of NOAA AVHRR data in raw, partially processed, and fully processed forms. The subgroup developed a short tutorial and a full tutorial, using altimeter data as an example. Members shared information on the compilation of data dictionaries for format description and on expert systems for format development. NASA's Earth Observing System (EOS) Data and Information System (EOSDIS) Program has been advising the subgroup on its activities relative to the selection of formats for EOS data distribution, and has included subgroup members in its survey of design criteria.

At the WGD-10 meeting in April 1991, members agreed on the importance of publishing and distributing CEOS WGD formats and other documentation. WGD members encourage Plenary member organizations to fully support this initiative.

At meetings in October 1992, WGD-13 restructured the Format Subgroup to take into account the need for evolution of format development activities (see Appendix A), while reaffirming support for the CEOS Superstructure. Specifying top-level requirements for the development of data format standards is among the five primary objectives for FS during 1993/1994.

The Format Subgroup has since compiled a list of all existing file classes and record codes currently used by WGD participants (available from the CEOS Library). This document, entitled "CEOS/LTWG Standard Family Format Record Codes, Construction Rules, and List of CEOS Agreed/Implemented Record Codes for Different Missions and for Different Originating Agencies," assists in satisfying the general criterion that formats should be as generic as possible. Early distribution of potential format documents minimizes the risk of multiple implementations for similar applications.

Geostationary Satellites

WGD has been tasked by the Coordination Group for Meteorological Satellites (CGMS) to develop common approaches for accessing geostationary data in coordination with CGMS members and other relevant organizations. Discussions with all the major participants will be held in early 1993.

Networks

During the first 3 to 4 years of its existence, WGD agreed that data exchange requirements as currently understood did not justify consideration of a dedicated communications network among member agencies; rather, WGD explored the availability of commercial communications capabilities to meet member needs. Future system plans have become clearer, and interest in global environmental monitoring has grown. Through the Economic Summit of Industrialized Nations, proposals have been introduced to establish data networks for global change. In response to this, WGD has recognized the need for additional work on networks.

During WGD-8 in April 1990, the formation of a CEOS WGD Network Subgroup (NS) was discussed to handle the technical issues related to ground-to-ground network links. The initial meeting of NS was held in November 1991, and its Terms of Reference were drafted and later approved by WGD (see Appendix A). ESA and NASDA serve as the NS co-chairs. Developed at NS-2 in February 1992, the NS Work Plan includes analysis of user-derived network requirements for catalog interoperability, browse, connectivity between agencies to support global change activities, and network applications projects [e.g., the International Satellite Cloud Climatology Project (ISCCP)].

Following its first meeting in November 1991, NS evaluated results of a NASA feasibility study to use the ISCCP data set as an initial exchange candidate for a pilot network demonstration project by electronic transmission. The study included an assessment of new procedures required to support electronic transfer. In April 1992, WGD-12 endorsed an expanded ISCCP network experiment with the following objectives: Using electronic networks to transfer data that are currently shipped, evaluating improvements in transfer time, and eventually distributing ISCCP data products to users. Another initiative involves an extensive review of the wide-area network infrastructure of each member agency to expand network connectivity to support Earth observations applications.

At the NS-3 meeting held in September 1992, it was decided to structure the NS Work Plan by projects—each one to be associated with identified user requirements, and to be characterized by purpose, objectives, and technical approach. All endorsed projects will be described in an integrated document, which will be the reference framework for all future activities. Within this work plan, projects will focus on the following topics, which are considered as main areas of activity:

- **Connectivity and topology**—Interconnection and interoperability between the different agencies are recognized as first priority objectives. They were extensively discussed, and agreement was reached on the opportunity to define a CEOS Earth System Global Network Concept. User requirements will be defined, and NS

will identify, propose, and support suitable network solutions. The Global Network Concept introduces different levels of service, and conveys the idea that large regional nodes shall be created (in the U.S., Europe, and Japan) in order to support the missions of CEOS member agencies and global change research/environmental monitoring projects. For connectivity between NASA and ESA [extended in Italy to the U.N. Food and Agriculture Organization (FAO)], the present Internet-based configuration, which provides the data transfer services only for a limited data size, was assessed and plans were agreed upon to improve connectivity between Goddard Space Flight Center (GSFC) and the European Space Research Institute (ESRIN) via high-capacity link.

- **Support to catalog interoperability**—The definition of the Global Network Concept and of the service levels offered is expected to help WGD CS in overcoming the difficulties presently experienced in characterizing meaningful and realistic network requirements affecting catalog interoperability.
- **Support to browse**—Although browse interoperability is not yet considered a real issue, problem areas were addressed at NS-3 (i.e., the need for improved file transfer mechanisms, difficulty in meeting time response requirements, usage of browse systems for other than catalog services, and the need to identify the key items that could affect interoperability). In this context, the AVHRR browse elements are considered part of the general browse activity.
- **Support to data delivery**—This category will include projects related to the delivery of large data sets (e.g., ISCCP).

Browse

At the fifth CEOS Plenary meeting in December 1991, the members directed WGD to accelerate activities related to the integration of browse or quick-look products into catalog systems. In April 1992, WGD-12 agreed that browse will be a separate agenda topic, with input by all WGD subgroups. It was recognized that browse crosses all WGD subgroups and that an unprecedented level of coordination is required among all three subgroups. A paper has been prepared that introduces the concept of end-to-end browse, and focuses on several related networking issues (e.g., performance and user requirements). At WGD-13 in October 1992, the browse issue was considered as an individual agenda item, and browse implementations were discussed. Because of the breadth of this subject, it was decided to hold an ad hoc meeting to consider browse issues and to define a top-level concept within which individual elements could be defined and developed.

Auxiliary Data Sets

During its meeting in April 1991, WGD established an ad hoc Working Group on Auxiliary Data Sets (WGADS), chaired by Deutsche Forschungsanstalt für Luft und Raumfahrt (DLR). It was envisioned that such an ad hoc group would first collect information about auxiliary data sets, then develop or recommend distribution standards as necessary and appropriate. WGADS-1 was held in October 1991, and agreement was reached on a draft definition for auxiliary data sets.

It was further agreed that efforts would be made by each agency to identify important auxiliary data sets and to generate DIF entries for the IDN coordinating with WGD CS. Some important auxiliary data sets fulfilling this definition were identified, and it was noted that the most fruitful auxiliary data sets are generated from agencies and institutions not directly involved in remote sensing—the International Space Year (ISY) Global Change Encyclopedia, the NOAA/Environmental Protection Agency (EPA) Global Change Database, the Defense Mapping Agency (DMA) Digital Chart of the World, and Digital Elevation Models (DEMs). During its meeting in November 1991, WGD endorsed several WGADS responsibilities:

- Encourage generation of DIFs for auxiliary data sets for entry to CEOS IDN, and develop extensions to the DIF to describe the auxiliary data sets

- Develop improvements to the CEOS Directory to better support auxiliary data sets
- Meet as an ad hoc group for 1 year, then present recommendations concerning establishment as a permanent group.

In February 1992, WGADS-2 concentrated on DEM availability. A worldwide elevation model generated from the DMA Digital Chart of the World was discussed, which resulted in the proposed Global Land 1-km Base Elevation (GLOBE) Project, to be carried out by participating agencies and international groups as is being done with the Global Land 1-km AVHRR Data Set Project. The goal is to generate a 1-km resolution DEM of the entire world.

In September 1992, WGADS-4 discussed various issues concerning DIF entries for auxiliary data sets, and recommendations were developed to modify DIF entries for the description of auxiliary data.

At the WGD-13 meeting in October 1992, WGADS became a standing body called the Auxiliary Data Subgroup (ADS), chaired by DLR. The Terms of Reference were provisionally approved (see Appendix A). The primary focus for ADS will be on auxiliary data sets in the framework of Earth observations, stressing interaction with CEOS affiliates [e.g., the International Geosphere-Biosphere Program (IGBP)] in special fields of global change research. The CEOS affiliates and programs falling under this rubric will be endorsed by WGD on a case-by-case basis. Some ongoing activities include expanding the controlled vocabulary of the DIF to better accommodate non-satellite data, addressing issues related to the data structure of non-satellite data as they relate to satellite data, and coordination with other groups. In addition, the GLOBE Project was reviewed and endorsed by WGD as a whole.

Global Land 1-km AVHRR Data Set Project

At the fifth CEOS Plenary meeting conducted in December 1991, the members approved the WGD recommendation concerning the Global Land 1-km AVHRR Data Set Project being conducted by NOAA, NASA, the U.S. Geological Survey (USGS), and ESA. Further participation was solicited from the Commonwealth Scientific and Industrial Research Organization (CSIRO), in cooperation with IGBP and other groups as appropriate. WGD is taking the lead by addressing the physical product specifications related to format, catalog system support, and networking requirements; IGBP has taken the lead in defining the products that will be needed to respond to scientific requirements.

Collection of the global data set began on April 1, 1992, with 22 High-Resolution Picture Transmission (HRPT) stations operationally acquiring daily data; NOAA Local Area Coverage (LAC) recorded data acquisitions fill in the gaps for areas generally not covered by the HRPT stations. Attention is being focused on processing of the data and definition of product specifications.

Technology Survey and News

In November 1991, WGD-11 members agreed to undertake an initiative to share information on ground system technologies, including data acquisition, data storage, data processing, data exchange and dissemination, data visualization, data access, and related standards. DLR has assumed the lead for this initiative, and is in the process of generating the following products:

- **Technology Survey**—Contains information on presently used technologies (as gathered from all WGD members), and will be produced, distributed, and maintained via a "Technology Library"

- **Technology News Flash**—Describes technological developments of interest (including announcements of new products); these news flashes are collected from all WGD members, edited by DLR, posted on the CEOS WGD Omnet bulletin board, and presented as a compendium at WGD meetings.

CEOS WGD Library

At WGD-4 in February 1988, NOAA accepted responsibility for serving as the WGD Librarian and began establishing a library at the Satellite Data Services Division of the National Environmental Satellite, Data, and Information Service (NESDIS) in Camp Springs, Maryland. WGD members submit formatting information and software to the library, and the responsibility for maintaining up-to-date documentation remains that of the submitter. The librarian stores and disseminates the information that has been provided.

The current library holdings are listed in Appendix D. WGD is exploring the possibility of putting the CEOS Library into an existing bibliographic system, possibly those maintained by ESA or NOAA. The goal is to provide bibliographic information on-line and eventually documents on-line.

Storage Media

CEOS has not recommended standardization of storage media, since this is an internal matter for each data center; rather, WGD ensures that user products are offered in CEOS-approved formats. Nonetheless, WGD recognizes the value of exchanging information among members about new storage technologies, particularly optical media. There is a standing action among members to exchange information on benchmark tests and other technical evaluations of new storage technologies. Copies of these reports are available from the CEOS Library.

WGD continues to exchange information about storage technologies and the development of common approaches for Earth observations data, although most coordination is accomplished as part of the Technology Survey and Technology News Flash bulletin board.

Lexicon

CEOS WGD is developing a lexicon to define terminology used in data management activity. Some lexicon terms have been agreed to by WGD and the U.S. Interagency Working Group on Data Management for Global Change (IWGDMGC). At present, lexicon terms are being defined by each subgroup. The process includes reviewing and incorporating terms from existing and emerging lexica.

Training

The CEOS Plenary recognized in its initial meeting the value of sharing information about training efforts for satellite data users. WGD has addressed training in remote-sensing applications from the standpoint of sharing common data sets for use in training programs. WGD has also developed tutorials on data formats and format standards, available from the CEOS Library, for use in training data managers. It was agreed that WGD would not establish training programs per se, but members are encouraged to share experiences and information related to training.

Data Management Guidelines

The Landsat Ground System Operators Working Group (LGSOWG) has attempted to establish criteria for retaining data; however, during its meeting in June 1991, LGSOWG agreed to ask for guidance from WGD. At its meetings in November 1991 and April 1992, WGD discussed such data management guidelines and agreed to explore potential mechanisms to address data retention and disposition.

Inter-Meeting Communications

Omnet lists specific to WGD and each of its subgroups have been established, as well as a WGD bulletin board.

Future Work Plans

Future work plans are described in the following subsections. Though not all-inclusive, specific details regarding subgroup activities correspond to the subheads provided in the previous section. To avoid redundancy, ongoing efforts are only repeated if they are considered a vital undertaking central to the individual subgroups' goals and objectives.

Catalog Systems

- Encourage CEOS member agencies to include on their delegations individuals who can effectively represent all agency or national requirements for directory services. This effort is necessary to show that steps are being taken by CEOS to be more inclusive and to highlight the CEOS commitment in keeping IDN responsive to users' needs.
- Encourage all member agencies, affiliates, and observers to provide timely and adequate resources to support the generation and maintenance of DIF descriptions for inclusion in CEOS IDN, in order to increase its usefulness to the Earth observations data user community.
- Complete work on promotional brochure that describes CEOS IDN, and attempt to obtain funding to print, publish, and distribute it.
- Finalize and distribute the "Guidelines for an Internationally Interoperable Catalog System" document, with a draft available by early 1993.
- Complete report on the Level III Catalog Interoperability Experiment to demonstrate Level 3 inventory interoperability by late 1993.
- Continue Catalog Subgroup/Consultative Committee on Space Data Systems (CS/CCSDS) Panel 2 coordination on standards.
- Continue development of an AVHRR browse exchange.

Data Formats

- Define and establish a set of high-level requirements for Earth science data formats and a complete format system. Requirements will be defined, taking into account the perspective of data users, distributors, archivers, and producers.
- Develop a project plan by May 1993, which includes activities aimed at adopting and/or developing formats that adhere to the defined requirements. The project plan will also address the development of a data dictionary

for data product content, the development of a CEOS data formats guidelines document, and format translation, convergence, and interoperability activities. The project plan will prioritize current activities, including the maintenance and evolution of the CEOS Superstructure and activities aimed at strengthening or establishing relations with other Earth science, formats, and standards organizations (e.g., CGMS and CCSDS). These plans will focus on specific implementation tasks associated with current CEOS-related development activities [e.g., Sea-Viewing Wide Field-of-View Sensor (SeaWiFS), Special Sensor Microwave/Imager (SSM/I), Global Ozone Monitoring Experiment (GOME), and geostationary meteorological satellites].

- Analyze the feasibility of the convergence or interoperability of formats to include the CEOS Superstructure, Hierarchical Data Format (HDF, which has been adopted as the standard data format for NASA's EOSDIS Version 0), and CCSDS standards, such as the Standard Formatted Data Unit (SFDU).
- Ensure permanent leadership for the Format Subgroup, while ensuring that ongoing work continues in the interim.

Networks

- Develop a structured Work Plan as a reference framework for future activities by the next Network Subgroup meeting (March-April 1993), to specifically address the following:
 - Connectivity and topology, and the need to define the CEOS Earth System Global Network concept, taking into account user requirements
 - Support to catalog interoperability, with the goal of facilitating realistic network requirements
 - Support to browse
 - Support to data delivery, including ISCCP.
- Continue ensuring that global change research is actively considered within the Network Subgroup role.
- Continue progress on the ISCCP Network Experiment and report at the next Network Subgroup meeting.
- Review each agency's wide-area network infrastructure and report at the next Network Subgroup meeting.

Browse

- Convene an ad hoc meeting in early 1993, to develop a strategic plan that defines the WGD goals and objectives for browse coordination; prioritize those tasks for specific assignments.

Auxiliary Data Sets

- Develop a work plan and schedule for presentation to WGD-14 (May 1993). It is expected that future activities will include the generation of a reference document describing the utilization of auxiliary data in satellite data processing and the review of the potential role of auxiliary data in satellite image interpretation and its interfaces to global change research.
- Identify specific tasks that WGD can undertake concerning the GLOBE project.

Global Land 1-km AVHRR Data Set Project

- Continue prototype and operational product preparation and generation tasks that began in September/October 1992, in support of Phase 2 goals and objectives. As a result, substantial coordination and guidance will be required from WGD in addressing the physical product specifications, catalog system, browse format, and networking requirements. It is anticipated that the final scientific product specifications and processing methodologies will be recommended by IGBP and the project team in early 1993.

Data Management Guidelines

- Defer drafting proposed data management guidelines until specific direction is received from the CEOS Plenary.

Inter-Meeting Communications

- Explore the feasibility of a system that provides easier access by WGD members than Omnet, with initial efforts focusing on the Internet.

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Summary and Objectives

The CEOS Working Group on Sensor Calibration and Geophysical Validation (WGCV) has met in formal session six times since its inception, with the latest meeting taking place in November 1992. The European Space Agency (ESA) chaired the group from 1984 to 1990, when chairmanship was transferred to Canada. At the fifth CEOS Plenary meeting in December 1991, WGCV offered new Terms of Reference and recommendations for endorsement by CEOS members. These were approved by the Plenary, and WGCV became a standing CEOS Working Group; consequently, the membership of WGCV was expanded in 1992, to include the CEOS observers and affiliates. WGCV recognized early that organizations outside the CEOS members prove critical to satellite sensor calibration and validation; as such, WGCV activities have been open to experts outside of CEOS with relevant knowledge of calibration/validation applications.

The objectives of WGCV are to enhance coordination and complementarity, to promote international cooperation, and to focus activities in the calibration and validation of Earth observations for the benefit of CEOS members and the international user community. Work to meet these objectives includes promoting exchange of technical information and documentation, investigating possibilities for technical coordination and cooperation for space and ground segments, coordinating calibration/validation campaigns and programs, and optimizing and sharing available facilities, expertise, and resources.

Accomplishments

WGCV has facilitated exchange of information on calibration and validation activities among members and the international community. Workshops have been conducted [e.g., synthetic aperture radar (SAR) calibration], and regular reports from WGCV members on current and planned calibration/validation activities have been generated. Focused specialist presentations on recent satellite missions have become a regular agenda item at WGCV meetings. An electronic bulletin board (i.e., CEOS.WGCV.NEWS/OMNET) has been established, and the first issue of a newsletter is scheduled for November 1992; the newsletter is to be issued twice a year. As with the electronic bulletin board, the newsletter will include calibration/validation news items, contact points for calibration/validation information, and updates of calibration/validation coefficients and associated information. In addition, a small WGCV Library has been set up, with background materials available to all CEOS participants. The following blurbs provide brief encapsulations of recent WGCV efforts:

- **Terminology**—WGCV is addressing the need for a common terminology, noting that different agencies and disciplines have used similar terms but with different meanings. Definitions for a number of critical terms are in draft form, and will be added to the CEOS Lexicon after endorsement by the Plenary.
- **Identification of opportunities for cooperation**—WGCV has established links with a number of groups involved in related activities, such as satellite coordination groups and other international bodies; since 1992, a number of these groups have worked directly with WGCV and its subgroups. Furthermore, close coordination with the CEOS Working Group on Data (WGD) has been fostered. WGCV members have identified common interests and planned aircraft campaigns, defined performance parameters to be measured, and so on. Specific interagency initiatives and collaborations are being investigated, such as inventories of test sites and calibration/validation campaigns.
- **Workshops and specialist presentations**—WGCV has held a number of meetings on specialized topics relating to calibration and validation. In 1992, as part of the WGCV-5 meeting, specialist presentations were given on the calibration and validation of sensors onboard the Upper Atmosphere Research Satellite (UARS)

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AND
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VALIDATION**

and European Remote Sensing Satellite-1 (ERS-1). At WGCV-6 in November 1992, sessions were held on the Brazilian space program and on the 1992 South American Radar Experiment. As part of the SAR Calibration Subgroup activities, a 4-day workshop was held in September 1992, which combined technical presentations with working sessions on methods, definitions, and parameters related to radiometry, geometry, and interferometry.

Future Work Plans

Following WGCV-5, two new subgroups were identified to address the following calibration/validation issues: Infrared and Visible Optical Sensors (IVOS) and Passive Microwave. These subgroups remain in the early stages of definition. The IVOS Subgroup is holding its first meeting in December 1992, with the National Oceanic and Atmospheric Administration (NOAA) the host.

An activity related to terrain mapping has been initiated, and the first meeting/workshop of interested members and experts is slated for December 1992, with the Jet Propulsion Laboratory (JPL) the host. Data formatting and transfer will be coordinated with WGD. Evaluation and documentation of test sites is being addressed through the above subgroups, with the possibility of the terrain mapping activity achieving subgroup status in the future. Specific objectives of this WGCV activity follow:

- Promote wider awareness and use of remote-sensing satellite data for terrain height determination, particularly measurements derived from ERS-1, Radarsat, the Japanese Earth Resources Satellite-1 (JERS-1), Systeme pour l'Observation de la Terre (SPOT), and the Earth Observing System (EOS).
- Promote an intercomparison of the state-of-the-art in different techniques for determining terrain heights from space and their validation, and work towards common terminology and determination of terrain height accuracies (via optical stereo, SAR stereo, SAR interferometry, shape-from-shading, laser altimetry, radar altimetry, among others)
- Identify and/or establish relatively stable test site(s) accessible by a variety of sensors, and provide reference data sets accurate enough to allow validation of various space methods and in suitable aggregated forms to meet different resolution requirements; data from the different sensors and reference data sets would be made available to CEOS participants.

At present, the SAR Calibration Subgroup is preparing discussion papers and special journal issues. In 1993, a special issue of the "Canadian Journal of Remote Sensing" will feature such collaborations. The next SAR Calibration Subgroup specialist workshop will be hosted by ESA in September 1993. The WGCV information exchange is continuing to develop through the Omnet bulletin board, the newsletter, and the planned specialist presentations. See Appendix A for the Terms of Reference for all the WGCV subgroups, which provides further details of ongoing and projected activities.

WGCV-7 is planned for the spring of 1993, and will include sessions on calibration/ validation programs and results from recent satellite missions [e.g., JERS-1 and the Ocean Topography Experiment (TOPEX)/Poseidon]. At this time, WGCV will finalize its format for its regular agency reports on calibration/ validation; one approach involves a mini-dossier (based on the "CEOS Dossier of Satellite Missions and Global Environmental Programs") with a matrix of calibration and validation activities.

Summary and Objectives

At the 1990 CEOS Plenary, Japan offered to host an ad hoc meeting of CEOS representatives to consider the creation of a Working Group on Space-to-Ground Networks (WGSN). The meeting was held at the National Space Development Agency (NASDA) facilities in Tsukuba on June 24-25, 1991. The WGSN points-of-contact who attended are listed in Appendix C. The objectives of the first meeting were to consider draft Terms of Reference for the creation of WGSN and an appropriate work plan, and to develop recommendations to be presented at the fifth CEOS Plenary. Specifically, the WGSN meeting participants sought to:

- Assess user requirements for space networks, especially as they relate to Earth observations satellites
- Evaluate the roles and responsibilities of existing groups that coordinate and recommend international standards related to space networks
- Review a draft Terms of Reference for CEOS WGSN.

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Accomplishments

Reports by members of WGSN summarized the needs and requirements of space agencies for space-to-space and space-to-ground networks. In addition, presentations were given by agency experts who participate in international standards groups concerned with space networks. The standards groups reviewed during the meeting included the following:

- Interagency Tracking, Communications, and Operations Panels (ITCOPs)
- Space Networks Interoperability Panel (SNIP)
- Consultative Committee for Space Data Systems (CCSDS)
- Space Frequency Coordination Group (SFCG).

The roles and responsibilities of CEOS WGD also were reviewed, and the boundaries separating the purview of WGSN and WGD discussed. In general, WGD deals with standards and formats of space data provided to users (as does CCSDS Panel 2). Thus, direct reception of satellite data would be an issue for WGSN, not for WGD. To help establish bounds for WGSN authority, the following scenarios for space networks were defined:

- Earth observations satellite data transfer to data relay satellites [e.g., the Tracking and Data Relay Satellite System (TDRSS)], then to the Earth (i.e., space-space-Earth)
- Earth observations satellite to ground station data transfer (i.e., space-Earth)
- Terrestrial networks for data exchange.

Based on member presentations, WGSN found that the first and second issues listed above are largely satisfied by SNIP, ITCOPs, and CCSDS Panels 1 and 3. The third issue is being addressed by CCSDS Panel 2 and the WGD Network Subgroup.

WGSN found that all of the major issues related to space networks were covered by existing standards or coordination groups, some of which were outside of CEOS. In fact, all WGSN goals listed in its draft Terms of Reference received attention from other international groups. Although most major issues related to space networks appeared to be covered

elsewhere, WGSN found several areas worth the attention of one or more panels of experts. The following recommendations were presented by the WGSN Chairperson to the CEOS 1991 Plenary:

- A group should be identified to collect and coordinate end-user requirements for real-time and near-real-time Earth observation data acquisition, and for delivery of these data to terrestrial networks.
- A group should be identified to coordinate Earth observations satellite data acquisition among CEOS members.
- The CEOS WGD Network Subgroup should be activated under a permanent chair to coordinate data exchange among CEOS members, to recommend exchange standards, and to evaluate requirements for space network interfaces to ground networks.

WGD took note of the third recommendation and modified the Terms of Reference for its Network Subgroup accordingly. NASDA and the European Space Agency (ESA) co-chair this subgroup, so no disruption of CEOS networking activity was experienced. Regarding the first two recommendations, WGD stated that such network activities would be treated on a case-by-case basis, and that WGD could not take overall responsibility for overall coordination. WGD's stance was endorsed by the fifth CEOS Plenary, and the incoming secretariat offered to address WGSN recommendations regarding collection and coordination of user requirements and ground infrastructure as part of its preparations for the next CEOS Plenary. As such, WGSN was discontinued as a CEOS working group, and its draft Terms of Reference have been deleted from Appendix A.



Committee on Earth Observations Satellites

APPENDIX A

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CEOS WORKING GROUP ON DATA

CEOS WORKING GROUP AND SUBGROUP TERMS OF REFERENCE

Membership

Membership in CEOS WGD is open to all members of CEOS as defined in the CEOS Terms of Reference. Members may include in their delegations to WGD meetings any participants who have relevant expertise to contribute to the objectives of WGD.

Objectives

The objective of WGD is to enhance coordination, complementarity, and standardization of spaceborne Earth observations data management for the benefit of the members and the international user community. This will be done initially through work in the following areas, with other topics to be added as may be agreed by WGD:

- User product formats
- Catalog systems
- Common lexicon and data dictionary
- Networks
- Storage and distribution media
- Data management strategies.

Among the specific goals of WGD are development, implementation, and maintenance of recommendations for:

- Common formats for user products generated by different organizations using data from a single sensor
- Common formats for user products generated from sensors of the same type operated by different entities
- Facilitating location and utilization of Earth observations data held by CEOS members and other entities.

Procedures

WGD shall meet approximately every 6 months, rotating venue among members. The Chairperson and Secretariat for WGD, designated by the Plenary, shall prepare and distribute minutes for each meeting. At each meeting of WGD, the time, place, and host for the next meeting shall be established.

CEOS WGD shall coordinate its work with other international groups involved in related activities as described in the CEOS Terms of Reference. In particular, at the direction of the second CEOS Plenary, WGD shall work closely with the Consultative Committee on Space Data Systems (CCSDS).

Each member shall designate a point-of-contact for WGD correspondence.

WGD may propose modifications to these Terms of Reference, and such modifications will be submitted to the Plenary for approval at the next Plenary meeting.

Subgroups may be established to perform detailed technical work in specific areas. Subgroups shall be established by the consensus of WGD. WGD shall develop Terms of Reference for each Subgroup. The Chairperson of each Subgroup shall report at each WGD meeting on the Subgroup's progress and plans.

The WGD Library shall serve as the repository for documents and other material, such as implementation tools as may be agreed upon by WGD.

WGD shall develop a common lexicon and data dictionary.

WGD shall develop additional procedures as may be required.

CEOS WGD CATALOG SUBGROUP

The objective of the CEOS WGD Catalog Subgroup is to develop and promote an approach for achieving an interoperable, international catalog system. A catalog system is a system by which a user can determine what data of interest exist, how they can be obtained, and how information can be acquired that supports the utilization of the data.

Specific issues to be considered by the Subgroup include:

- Master directory
- Inventory
- Connectivity between directory and inventory modules
- Guide (catalog)
- Models
- Browse.

Recommendations developed by the Catalog Subgroup will be passed on to the full WGD for concurrence. The Subgroup expects to receive direct, semi-annual guidance from WGD on the scope and nature of the catalog issues that it is to consider during each 6-month interval.

Membership to the Catalog Subgroup is primarily limited to the member agencies of WGD. Each agency is encouraged to select a primary point-of-contact having the following qualifications:

- Able to regularly attend Subgroup meetings
- Possesses technical expertise in directory, catalog, and inventory issues
- Demonstrates cognizance of the importance of end-user requirements in all phases of development and implementation of catalog systems.

The Catalog Subgroup will meet at least every 6 months, preferably within a month before scheduled WGD meetings in order to facilitate the timely transfer of recommendations to WGD for concurrence.

CEOS WGD FORMAT SUBGROUP

Purpose and Scope

The primary purpose of the Format Subgroup is to promote, through data format standards, access to Earth observation and related data taking into account the requirements of both its users and producers. The subgroup has “championed” the use of the “CEOS family of formats” and will continue to support its currency. The next generation of sensors and satellites in the late 1990s represents a significant increase in the volume and diversity of data, also there have been significant developments in computer, network, and media technology; the need for data format standards that can be applied universally has never been greater. Such standards must facilitate the easy and efficient access to data whilst addressing the practical constraints of backward compatibility, longevity, maintenance, cost, and the different implications of distribution and archive exchange formats. Standard data formats provide one of the key building blocks for sound data management practice.

Objectives

The specific objectives to be tackled during the next 2 years are as follows:

- Maintain and control the format standard and specific formats currently approved by CEOS
- Specify top-level requirements for the development of data format standards
- Make recommendations on data format standards for the next generation of Earth observation satellite data and related data for adoption by member agencies
- Provide guidance for the development and implementation of data format standards by member agencies; this guidance should focus on the content, and its presentation and organization, of formats to ensure that user’s requirements are met in a well-identified data structure
- Promote the adoption and development of a data format standard or set of standards that minimize redundant software development, that cover all Earth observation satellite and related data, and that support both distribution to users and interchange between agencies.

These objectives will be pursued taking into account the Subgroup’s experience in areas such as media, file systems, format, data structure, science data content, and tools (e.g., analysis, visualization, format implementation), and applying this to specific example data sets such as SeaWiFS, GOME, and geostationary satellite data sets.

In all activities the Subgroup will coordinate and liaise with the other WGD Subgroups and other international format standards groups (e.g., CCSDS, WMO, ISO), as appropriate.

Membership

Membership of the Subgroup is primarily limited to member, affiliate, and observer agencies of WGD. Each agency is encouraged to select a primary point-of-contact having the following qualifications:

- Able to regularly attend Subgroup meetings
- Possesses expertise in data formats, both from an Earth observation user and computer science/engineering perspective

- Demonstrates an understanding of the importance of data access and the role of the user in defining requirements for data access
- Appreciates and understands the role and limitations of CEOS in international data management coordination.

CEOS WGD SAR SUBGROUP

This CEOS WGD subgroup was dissolved and merged with the CEOS WGD Format Subgroup in October 1992; hence, its Terms of Reference have been deleted from the 1992 edition of the "CEOS Consolidated Report."

CEOS WGD NETWORK SUBGROUP

Purpose and Scope

CEOS WGD has formed a Network Subgroup to actively address the crucial issues of user-to-user communication using terrestrial (ground-to-ground) networking. This excludes dealing with issues related to space networking [i.e., space-to-space (data relay satellites) and space-to-ground/ground-to-space (real-time data acquisition or satellite control)] handled by other groups outside CEOS. There is a need to use terrestrial networks to deliver a variety of data, including catalog (directory, guide, and inventory) information, browse and quick-look imagery, or other metadata as well as raw data sets or derived data sets. Data may be delivered routinely or on an ad hoc basis, in near-real-time or retrospectively. Data volumes and rates may be high or low. In some cases, near-real-time ground networking activities will need to be coordinated with space networking activities.

The CEOS WGD Network Subgroup shall pass its recommendations to WGD for endorsement and will accept direction from WGD.

The CEOS WGD Network Subgroup is tasked to coordinate with the CEOS WGD Catalog Subgroup in order to ensure that the proper physical network links are available to support all levels of catalog interoperability.

The CEOS WGD Network Subgroup is tasked to coordinate with CEOS WGD in order to ensure that the proper physical network links are available to support high-volume data transfer.

In order to accomplish the specified objectives, the CEOS WGD Network Subgroup should examine current network capabilities and make recommendations for new capabilities and standards (in coordination with relevant organizations and network providers) based on user requirements.

Given a set of network support requirements for applications of interest (e.g., metadata, browse, quick-look, or data transfer on an ad hoc or routine basis) by WGD or its Subgroups, the CEOS WGD Network Subgroup should:

- Determine the network architecture, transfer rate, protocols, data compression, and other performance requirements of the given application
- Recommend alternatives for implementation, including estimated initial and ongoing costs, and make maximum use of existing network services
- Plan, develop, and coordinate the implementation of pilot projects as recommended by CEOS WGD.

The Network Subgroup shall meet nominally twice a year.

All agencies or countries that meet eligibility requirements for participation in CEOS are encouraged to designate to the WGD Network Subgroup one or more representatives with the following qualifications:

- The designate(s) should be able to regularly attend Network Subgroup meetings.
- The designate(s) should be cognizant of country- or agency-related network initiatives.
- The designate(s) should understand the capabilities and limitations of internetwork connectivity.
- The designate(s) should understand the end-user requirements.

CEOS WGD AUXILIARY DATA SUBGROUP

The primary purpose of the CEOS WGD Auxiliary Data Subgroup (ADS) is to provide, within CEOS, a forum to harmonize and coordinate data management issues for those data sets judged to be auxiliary from frame of reference of Earth observations from space. In this context, auxiliary data sets are those collected by any platform or process that directly enhance the utilization of data derived from Earth observations satellites. On a time-available basis and with approval from WGD, ADS may also seek to harmonize and coordinate data management issues for those data sets judged to be auxiliary from the frame of reference of global change research. In this context, auxiliary data sets are those collected by any platform or process that directly or indirectly enhance the processing, utility, or exploitation of data derived from Earth observations satellites and used in global change research.

Specific objectives of ADS include:

- Encouraging and coordinating the participation of relevant member agencies in focused projects that strive to generate, compile, and/or document specific auxiliary data sets
- Collecting and integrating requirements for auxiliary data sets used in the generation of products derived from remotely sensed data
- Coordinating with the WGD Catalog Subgroup for CEOS International Directory Network (IDN) population efforts, for review of catalog system recommendations and standards vis-a-vis support for auxiliary data sets, and for encouraging wider dissemination of recommendations for the creation of interoperable catalog system elements
- Coordinating with the WGD Format Subgroup on the application and translation of formats standards (existing or newly developed) for auxiliary data sets
- Coordinating with the WGD Network Subgroup to identify access (bandwidth and performance) requirements for selected auxiliary data sets
- Coordinate with other relevant external organizations, as appropriate.

Recommendations developed by ADS will be passed on to WGD for concurrence. ADS expects to receive direct semi-annual guidance from WGD, and the scope and nature of auxiliary data set issues that it is to consider during each 6-month interval.

Membership

Membership in WGD ADS is primarily limited to member, observer, and affiliate agencies of CEOS WGD. Each agency is encouraged to select a primary point-of-contact having the following qualifications:

- Able to regularly attend ADS meetings
- Possesses expertise in various aspects of satellite data processing
- Understands the role of satellite, in situ, and correlative data in global change research endeavors
- Appreciates and understands the role and limitations of CEOS in international data management coordination
- Demonstrates cognizance of the importance of end-user requirements in data management planning.

ADS will meet at least every 6 months, preferably within 4 to 6 weeks before scheduled WGD meetings in order to facilitate the timely transfer of recommendations to CEOS WGD for concurrence.

CEOS WORKING GROUP ON SENSOR CALIBRATION AND GEOPHYSICAL VALIDATION

Membership

Membership in CEOS WGCV is open to all members of CEOS as defined in the CEOS Terms of Reference, including observers and affiliates. Members may include in their delegations to WGCV meetings any participants who have relevant expertise to contribute to the WGCV objectives.

Objectives

The objectives of WGCV are to enhance coordination and complementarity, to promote international cooperation, and to focus activities in the calibration and validation of Earth observations for the benefit of CEOS members and the international user community. Work to meet these objectives includes the exchange of technical information and documentation; investigation of possibilities for technical coordination and cooperation for space and ground segments; coordination of calibration and validation campaigns and programs; and optimizing and sharing available facilities, expertise, and resources as appropriate. Specific objectives follow:

- **Sensor-specific calibration and validation**—Document and establish fora for the assessment and recommendation of current techniques and standards for pre- and post-launch characterization and calibration
- **Geophysical validation**—Document and establish fora for the assessment and recommendation of techniques for validation of geophysical parameters derived from Earth observations satellite systems.

Procedures

WGCV shall meet when appropriate (at least once per year), rotating venue among members. The chairperson and secretariat for WGCV, designated by the Plenary, shall prepare and distribute minutes for each meeting. At each WGCV meeting, the time, place, and host for the next meeting shall be established. In addition, each member shall prepare a report on its current and planned calibration and validation activities.

CEOS WGCV shall coordinate its work with other international groups involved in related activities, as described in the CEOS Terms of Reference.

Each member shall designate a point-of-contact for WGCV correspondence.

WGCV may propose modifications to these Terms of Reference, and such modifications will be submitted to the Plenary for approval at the next Plenary meeting.

Subgroups may be established to perform detailed technical work in specific areas. Subgroups shall be established by the consensus of WGCV. WGCV shall develop Terms of Reference for each subgroup. The chairperson of each subgroup shall report at each WGCV meeting on the subgroup's progress and plans.

The WGCV Library shall serve as the repository for documents, such as meeting minutes and reports produced by WGCV, and other material as may be agreed by WGCV.

WGCV shall work towards developing agreement on common terminology.

WGCV shall develop additional procedures as may be required.

CEOS WGCV SAR CALIBRATION SUBGROUP

Objectives

- Establish a recommended set of synthetic aperture radar (SAR) performance assessment techniques for quality control
- Establish a recommended set of standards for calibration techniques (internal and external), formats, and definitions
- Coordinate multi-national calibration campaigns to develop expertise for intra- and cross-sensor calibration
- Support European Remote Sensing Satellite-1 (ERS-1) and Spaceborne Imaging Radar-C/X-Band Synthetic Aperture Radar (SIR-C/X-SAR) calibration activities as focal points for developing common calibration procedures
- Educate the science community (through support of papers, seminars, workshops) on the capabilities and limitations of SAR sensors

CEOS WGCV INFRARED AND VISIBLE OPTICAL SENSORS SUBGROUP

Membership

Membership in the IVOS Subgroup is open to those members of CEOS WGCV who have a specific interest in the calibration or validation of spaceborne infrared and visible sensors. Membership also includes specialists in the calibration and validation of infrared and visible sensors.

Objectives

IVOS Subgroup objectives are the same as those for CEOS WGCV, with the following emphases:

- Promote international and national collaboration in the calibration and validation of all IVOS and thus assist in the improved application of data from satellite instruments
- Include all sensors (ground based, airborne and satellite) where there is a direct link to the cal/val of satellite sensors
- Identify and agree on calibration and validation requirements and standard specifications for IVOS
- Identify test sites and encourage continuing observations and inter-comparison of data from these sites
- Encourage the timely and unencumbered release of data relating to cal/val activities including details of pre-launch and in-flight calibration parameters

CEOS WGCV PASSIVE MICROWAVE SUBGROUP

Membership

Membership in the CEOS Passive Microwave Calibration Subgroup (P_μSG) is open to all members of CEOS as defined in the CEOS Terms of Reference, including observers and affiliates. Members may include in their delegations to P_μSG meetings any participants who have relevant expertise to contribute to P_μSG objectives.

Objectives

P_μSG objectives are to enhance coordination and complementarity of microwave radiometry technology, to promote international cooperation, and to focus activities in the calibration and validation of Earth observations in the realm of passive microwave technology for the benefit of CEOS members and the international user community.

P_μSG was established to support CEOS WGCV, and is authorized to deal with specific calibration and validation issues concerned with passive microwave measurements and observations. Work to meet these objectives includes the exchange of technical information and documentation; investigation of possibilities for technical coordination and cooperation for space and ground segments; coordination of calibration and validation campaigns and programs; optimization and sharing of available facilities, expertise, and resources as appropriate; and advice to WGCV on issues of microwave radiometry. Specific P_μSG objectives follow:

- Ground calibration
 - Laboratory-type standard calibration targets
- Investigate electromagnetic characteristics of reference targets
- Investigate methods for establishing reference temperatures
 - Field-use portable standard calibration targets
 - Antenna characterization range

- In-flight (spaceborne) calibration targets
 - Investigate and build calibration reference target designs
 - Characterize reference target designs
 - Perform end-to-end analyses of in-flight calibration techniques
- Field validation experiments
 - Investigate joint field calibration and validation programs of broad international interest in support of Mission to Planet Earth (MTPE) space observing systems
 - Develop national support to implement appropriate field validation experiments.

Procedures

P_LSG shall meet when appropriate (at least once per year), rotating the meeting locations among members. At each P_LSG meeting, the time, place, and host of the next scheduled meeting shall be established. The P_LSG convener shall be responsible for establishing a set of minutes for that subgroup meeting, and distribute them promptly to the subgroup participants and the WGCV chair. For each P_LSG meeting, each member shall prepare a report on respective current and planned microwave radiometer calibration and validation activities. A report on these activities shall be provided at each WGCV meeting.

Each member shall designate a point-of-contact for P_LSG activity and correspondence. P_LSG shall coordinate its work with other international groups involved in related activities. P_LSG may propose modifications to these Terms of Reference and submit them to the CEOS Plenary for approval.

P_LSG shall work towards agreement on common calibration and validation terminology.

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Committee on Earth Observations Satellites

APPENDIX B

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CEOS MEMBERSHIP

Organization	Location	Date of Membership
Members		
Canadian Space Agency (CSA)	Canada	1984
Centre National d'Etudes Spatiales (CNES)	France	1984
European Space Agency (ESA)	Europe	1984
Indian Space Research Organization (ISRO)	India	1984
Instituto Nacional de Pesquisas Espaciais (INPE)	Brazil	1984
Science and Technology Agency (STA)	Japan	1984
National Aeronautics and Space Administration (NASA)	U.S.	1984
National Oceanic and Atmospheric Administration (NOAA)	U.S.	1984
British National Space Centre (BNSC)	U.K.	1986
Agenzia Spaziale Italiano (ASI)	Italy	1986
Deutsche Agentur fur Raumfahrtangelegenheiten (DARA)	Germany	1986
Commonwealth Scientific and Industrial Research Organization (CSIRO)	Australia	1989
European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)	Europe	1989
Swedish National Space Board (SNSB)	Sweden	1991
Observers		
Norwegian Space Centre (NSC)	Norway	1990
Canada Centre for Remote Sensing (CCRS)	Canada	1990
Crown Research Institute (CRI)	New Zealand	1990
Commission of European Communities (CEC)	Europe	1991
Affiliates		
International Council of Scientific Unions (ICSU)	France	1991
International Geosphere-Biosphere Program (IGBP)	Sweden	1991
Intergovernmental Oceanographic Commission (IOC)	France	1991
World Climate Research Program (WCRP)	Switzerland	1991
World Meteorological Organization (WMO)	Switzerland	1991
United Nations Environment Program (UNEP)	Kenya	1992
Global Climate Observing System (GCOS)	Switzerland	1992
Global Ocean Observing System (GOOS)	France	1992

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Committee on Earth Observations Satellites

APPENDIX C

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CEOS PLENARY PRINCIPALS AND POINTS-OF-CONTACT

**CEOS
POINTS-
OF-
CONTACT**

Members

Canadian Space Agency (CSA)

Dr. Garry Lindberg (Principal)

Ms. Lyn McNutt (Contact)

Centre National d'Etudes Spatiales (CNES)

Mr. Jean-Daniel Levi (Principal)

Dr. Isaac Revah (Contact)

European Space Agency (ESA)

Mr. Philip Goldsmith (Principal)

Dr. Guy Duchossois (Contact)

Indian Space Research Organization (ISRO)

Prof. U.R. Rao (Principal)

Mr. M.G. Chandrasekhar (Contact)

Instituto Nacional de Pesquisas Espaciais (INPE)

Mr. Marcio N. Barbosa (Principal)

Mr. Roberto P. da Cunha (Contact)

Science and Technology Agency (STA)

Mr. Tsuyoshi Maruyama (Principal)

Mr. Yukio Haruyama (Contact)

National Aeronautics and Space Administration (NASA)

Dr. Shelby Tilford (Principal)

Ms. Lisa Robock Shaffer (Contact)

National Oceanic and Atmospheric Administration (NOAA)

Mr. Greg Withee (Principal)

Mr. J. Hussey (Principal)

Dr. Brent Smith (Contact)

British National Space Centre (BNSC)

Mr. Arthur Pryor (Principal)

Dr. David Williams (Contact)

Agenzia Spaziale Italiano (ASI)

Prof. Luciano Guerriero (Principal)

Mr. Bizzarro Bizzarri (Contact)

Deutsche Agentur für Raumfahrtangelegenheiten (DARA)

Prof. Heinz Stoewer (Principal)

Dr. Werner Menden (Contact)

Commonwealth Scientific and Industrial Research Organization (CSIRO)

Dr. Graham Harris (Principal)

Mr. Jeff Kingwell (Contact)

European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)

Mr. John Morgan (Principal)

Ms. Silvia Garcia-Castaner (Contact)

Swedish National Space Board (SNSB)

Prof. Kerstin Fredga (Principal)

Mr. Per Nobinder (Contact)

Observers

Norwegian Space Center (NSC)

Mr. Georg Rosenberg (Principal)

Mr. Georg Rosenberg (Contact)

Canada Centre for Remote Sensing (CCRS)

Dr. Leo Sayn-Wittgenstein (Principal)

Dr. Susan Till (Contact)

Crown Research Institute (CRI)

Dr. A. Pearce (Principal)

Ms. Stella Belliss (Contact)

Commission of European Communities (CEC)

Dr. H.J. Allgeier (Principal)

Dr. R. Klersy (Contact)

Affiliates

International Council of Scientific Unions (ICSU)

Ms. Julia Marton-Lefevre (Principal)

Ms. Julia Marton-Lefevre (Contact)

International Geosphere-Biosphere Program (IGBP)

Dr. J. Marks (Principal)

Dr. I. Rasool (Contact)

Intergovernmental Oceanographic Commission (IOC)

Dr. Gunnar Kullenberg (Principal)

Dr. Gunnar Kullenberg (Contact)

World Climate Research Program (WCRP)

Dr. Pierre Morel (Principal)

Dr. Pierre Morel (Contact)

World Meteorological Organization (WMO)

Mr. J. Rasmussen (Principal)

Dr. D.E. Hinsman (Contact)

United Nations Environment Program (UNEP)

Mr. S. Estecv (Principal)

Mr. M.D. Gwynne (Contact)

Global Climate Observing System (GCOS)

Dr. T.W. Spence (Principal)

Dr. T.W. Spence (Contact)

CEOS WORKING GROUP ON DATA POINTS-OF-CONTACT

Working Group Proper

NOAA	Levin Lauritson (Chair) Betty Howard Gary Metz/USGS
CSA	Specific contact(s) not designated
CNES	Christophe Dabin Alain Podaire
ESA	Luigi Fusco/Earthnet

ISRO	Specific contact(s) not designated K.R. Sridhara Murthi (Participant)
INPE	Specific contact(s) not designated Jose Aguirre (Participant)
STA	Specific contact(s) not designated Hironori Maejima/NASDA (Participant)
NASA	Gregory Hunolt
BNSC	Specific contact(s) not designated Alan Haskell/RAE (Participant) Paul Howard/EODC (Participant)
ASI	Specific contact(s) not designated Danilo Piaggese/Telespazio
DARA	Arndt Langner Joerg Gredel/DLR
CSIRO	Erik Elmar/ACRES (Participant)
EUMETSAT	Horst Faas
SNSB	Stefan Zenker
NSC	Specific contact(s) not designated Lill-Goril Seljelv/Tromso (Participant) Einar Gronas/Spacetec (Participant)
CCRS	Terry Fisher (Participant)
DSIR	Specific contact(s) not designated Stella Belliss
CEC	Specific contact(s) not designated
ICSU/IGBP	Specific contact(s) not designated Dean Graetz (Participant)
IOC	Specific contact(s) not designated
WCRP	Specific contact(s) not designated
WMO	Dieter Schiessl
UNEP	Harvey Croze
GCOS	Specific contact(s) not designated

WGD Catalog Subgroup

NOAA	George Saxton (Chair) Lyndon Oleson/USGS
CSA	Specific contact(s) not designated
CNES	Claude Huc
ESA	Gerhard Triebing/ESRIN
ISRO	Specific contact(s) not designated
INPE	Specific contact(s) not designated Jose Aguirre (Participant)

STA	Takashi Moriyama/NASDA
NASA	Jim Thieman/GSFC
BNSC	Mark Elkington/EODC
ASI	Specific contact(s) not designated
DARA	Hartwig Schroeter/DLR
CSIRO	Jeff Kingwell
EUMETSAT	Specific contact(s) not designated
SNSB	Stefan Zenker

NSC	Specific contact(s) not designated Nils Lunde (Participant)
CCRS	Terry Fisher
DSIR	Specific contact(s) not designated
CEC	Specific contact(s) not designated

ICSU/IGBP	Specific contact(s) not designated
IOC	Specific contact(s) not designated
WCRP	Specific contact(s) not designated
WMO	Specific contact(s) not designated
UNEP	Specific contact(s) not designated
GCOS	Specific contact(s) not designated

WGD Format Subgroup

Temporarily rotating chairmanship; NASA/ESA to chair FS-6 in February 1993

ESA	C. Nill/ESRIN L. Fusco/ESRIN
NASA	T. Meyer
CNES	C. Dabin
BNSC	A. Haskell (Interim)
SNSB	J. Forsgren/Satellitbild
CCRS	T. Fisher (Interim)
ACRES	E. Elmar (Interim)
DLR	J. Gredel (Interim)

WGD Network Subgroup

ESA	A. Bodini/Earthnet (Co-Chair)
NASDA	H. Kikuchi (Co-Chair)
CNES	M. Portal
INPE	J. Aguirre
NASA	R. Desjardins E. Lucier

NOAA	G. Saxton G. Barton L. Oleson/USGS
BNSC	M. Palmer
SNSB	S. Zenker
NSC	N. Lunde
CCRS	T. Fisher B. McLeod
WMO	D. Schiessl
DLR	D. Sundermann T. Ruwwe/DARA

WGD Auxiliary Data Subgroup

DLR D. Schreier (Chair)

Contacts will be named before the subgroup's first meeting, which is scheduled for April 26-28, 1993.

CEOS WORKING GROUP ON SENSOR CALIBRATION AND GEOPHYSICAL VALIDATION POINTS-OF-CONTACT

Working Group Proper

CSA	Dr. Susan Till/Canada Centre for Remote Sensing (Chair)
CNES	Dr. Didier Massonnet and Dr. Yves Menard
ESA	Dr. Evert Attema
ISRO	Mr. M.G. Chandrasekhar and Mr. A. Kiran Kumar
INPE	Dr. Decio C. Ceballos
STA	Dr. Masanobu Shimada
NASA	Dr. Robert Schiffer and Dr. Ghassem Asrar
NOAA	Mr. John Sherman and Mr. Walter Planet
BNSC	Mr. Mark Hutchins and Dr. David Llewellyn-Jones
ASI	Dr. Fabrizio Pauri
DARA	Mr. Michael Eineder
CSIRO	Dr. Ian Barton
EUMETSAT	Dr. Gerard Szejwach
SNSB	Dr. Hartmut Ziemann
NSC	Mr. Dan J. Weydahl
CCRS	Dr. Susan Till
DSIR	Mr. M.A. Collins
CEC	Dr. Peter Churchill and Dr. Carlo Lavalley
ICSU/IGBP	Dr. Philippe Teillet
IOC	Mr. John Withrow

WCRP Dr. Robert Schiffer
WMO Dr. Jaan Kruus

WGCV SAR Calibration Subgroup

Dr. A. Freeman/National Aeronautics and Space Administration (Chair)

WGCV Infrared and Visible Optical Sensors Subgroup

Dr. Ian Barton/Commonwealth Scientific and Industrial Research Organization (Chair)

WGCV Passive Microwave Subgroup

Dr. B. Guenther/National Aeronautics and Space Administration (Chair for 1992)

WGCV Terrain Mapping Activity

Dr. A. Freeman/National Aeronautics and Space Administration
(Chair for 1992, to be transferred in 1993)

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Committee on Earth Observations Satellites

APPENDIX D

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CEOS WGD LIBRARY

CEOS DOCUMENTS

IGSOWG Computer-Compatible Tape (CCT) Format Change Control Board (CCB) and Other Landsat Documents

Standard CCT Format Family Requirements	CCB-CCT-0001B
The Standard CCT Family of Tape Formats	
Addendum for File Class Imagery Optional (IMOP)	CCB-CCT-0002E
Landsat Technical Working Group (LTWG) Recommendation for a Landsat Thematic Mapper (TM) CCT Format	CCB-CCT-0003
IGSOWG Computer-Compatible Tape Format CCB Operations	CCB-OPR 0001A
IGSOWG CCB Information and Technical Support Group Central Library Operating Procedures	LIB-REF-0001
User's Guide for Landsat Thematic Mapper CCT	FOR-LSA-0004
LTWG Enhanced Thematic Mapper (ETM) Product Format	
Tables for the Landsat 6 Level 0 CCT Format Version 1.2	

AVHRR High-Resolution Picture Transmission (HRPT)

Standard Family HRPT Archive Request Product (SHARP)	ESA
Raw Data (Level 1A IMOP)	CCRS
Geocomposite (Level 3)	CCRS
SHARP Level 1B	NOAA

TIROS Operational Vertical Sounder (TOVS)

Level 1 (SHARP)	ESA
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Coastal Zone Color Scanner (CZCS)

Level 1	ESA
Level 2	ESA

Marine Observation Satellite-1 (MOS-1) [including user guides]

Microwave Scanning Radiometer (MSR)	Two formats: NASDA and ESA
Visible and Thermal Infrared Radiometer (VTIR)	Two formats: NASDA and ESA
Multispectral Electronic Self-Scanning Radiometer (MESSR)	One format: NASDA
Data Collection System (DCS)	One format: NASDA

Synthetic Aperture Radar (SAR)

Family of Formats	
ERS-1 Annotated Raw Data	ESA
ERS-1 Fast Delivery Copy	ESA
ERS-1 Single Look Complex	ESA
ERS-1 Precision Image	ESA
ERS-1 Ellipsoid Geocoded Image	ESA
ERS-1 Terrain Geocoded Image	ESA
ERS-1 SAR Format	CCRS

Systeme pour l'Observation de la Terre (SPOT) Standard Format

CD-ROM

Standard Format for Use of CD-ROM

CCRS

Sea-Viewing Wide Field Sensor (SeaWiFS) [unofficial first draft]

SEASDIS Level 0

NASA

SEASDIS GAC

NASA

SEASDIS LAC

NASA

Other

Terms of Reference for other international groups

Tutorials

CEOS Superstructure (Short and Long)

CCRS

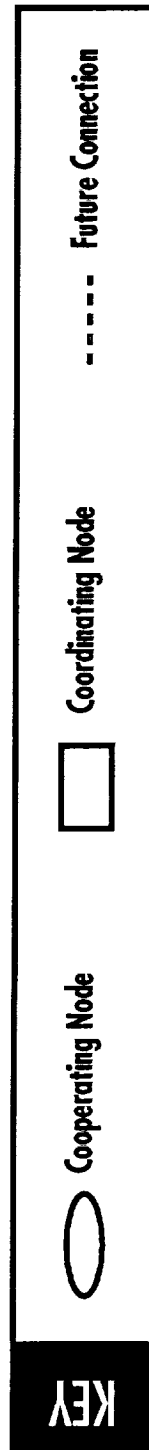
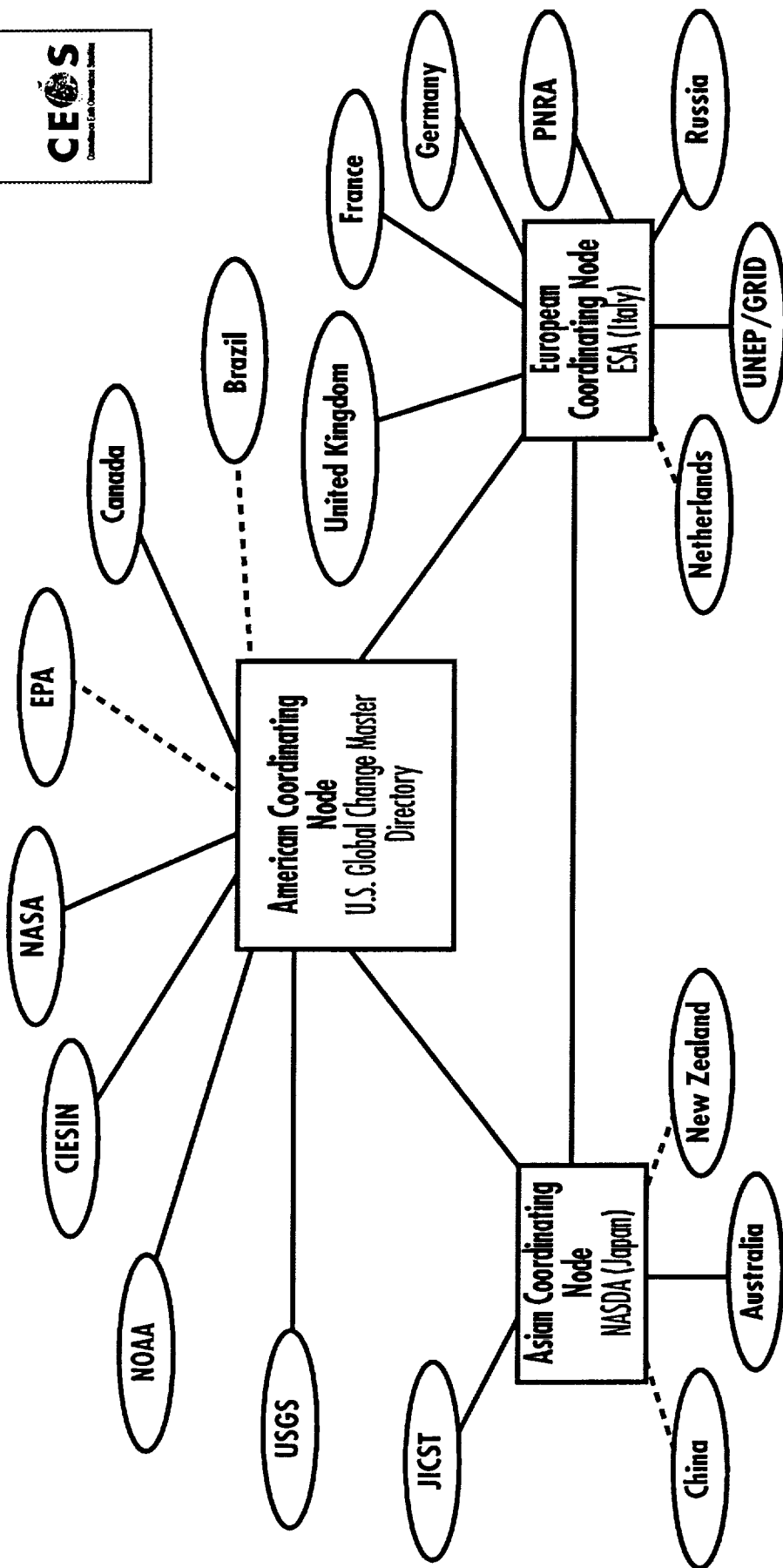
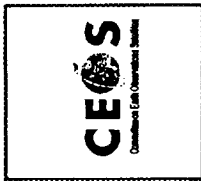
CCSDS Standard Formatted Data Unit (SFDU)

NASA

Directory Interchange Format (DIF)

NASA

Note: To show the value of such tutorials in promoting standard format development, the WGD Format Subgroup Chairperson used the CEOS Superstructure tutorial as a test case—giving the details of the Superstructure, then defining a specific format using a Ocean Topography Experiment (TOPEX)/Posedon Geophysical Data Record (GDR).



October 1992

CEOS INTERNATIONAL DIRECTORY NETWORK

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Committee on Earth Observations Satellites

APPENDIX E

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ACRONYM LIST

ACRES	Australian Centre for Remote Sensing
ADEOS	Advanced Earth Observing System
ADS	Auxiliary Data Subgroup
ASI	Agenzia Spaziale Italiano
ATLAS	Atmospheric Laboratory for Applications and Science
ATSR	Along-Track Scanning Radiometer
AVHRR	Advanced Very High-Resolution Radiometer
BEST	Bilan Energetique du Systeme Tropical
BNSC	British National Space Centre
CBERS	China-Brazil Earth Remote-Sensing Satellite
CCB	Change Control Board
CCRS	Canada Centre for Remote Sensing
CCSDS	Consultative Committee on Space Data Systems
CCT	Computer-Compatible Tape
CEC	Commission of European Communities
CEOS	Committee on Earth Observations Satellites
CGMS	Coordination Group for Meteorological Satellites
CIESIN	Consortium for International Earth Science Information Network
CINTEX	Catalog Interoperability Experiment
CIS	Commonwealth of Independent States
CLOS	Coordination on Land Observation Satellites
CLRSS	Coordination on Land Remote-Sensing Satellites
CNES	Centre National d'Etudes Spatiales
CORSS	Coordination on Ocean Remote-Sensing Satellites
COSSA	CSIRO Office of Space Science and Applications
CRI	Crown Research Institute
CS	Catalog Subgroup
CSA	Canadian Space Agency
CSIRO	Commonwealth Scientific and Industrial Research Organization
CZCS	Coastal Zone Color Scanner
DARA	Deutsche Agentur für Raumfahrtangelegenheiten
DCS	Data Collection System
DEM	Digital Elevation Model
DIF	Directory Interchange Format
DLR	Deutsche Forschungsanstalt für Luft und Raumfahrt
DMA	Defense Mapping Agency
DRS	Data Relay Satellite
DSIR	Department of Scientific and Industrial Research
EC	European Community
ENVISAT	Environmental Satellite
EODC	Earth Observation Data Centre
EO-ICWG	Earth Observations International Coordination Working Group
EOS	Earth Observing System
EOSDIS	EOS Data and Information System

EPA	Environmental Protection Agency
ERS	European Remote-Sensing Satellite
ESA	European Space Agency
ESRIN	European Space Research Institute
ETM	Enhanced Thematic Mapper
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FAO	Food and Agriculture Organization
FS	Format Subgroup
GAC	Global Area Coverage
GCOS	Global Climate Observing System
GDR	Geophysical Data Record
GLOBE	Global Land 1-km Base Elevation
GMS	Geostationary Meteorological Satellite
GOES	Geostationary Operational Environmental Satellite
GOME	Global Ozone Monitoring Experiment
GOOS	Global Oceanographic Observing System
GRID	Global Resources Information Database
GSFC	Goddard Space Flight Center
HDF	Hierarchical Data Format
HRPT	High-Resolution Picture Transmission
ICSU	International Council of Scientific Unions
IDN	International Directory Network
IEF	Inventory Exchange Format
IEOS	International Earth Observing System
IEOSC	International Earth Observations Satellite Committee
IFEOS	International Forum for Earth Observations using Space Station Elements
IGBP	International Geosphere-Biosphere Program
IGBP/DIS	IGBP Data and Information System
IMOP	Imagery Optional
INPE	Instituto Nacional de Pesquisas Espaciais
INSAT	Indian Satellite
IOC	Intergovernmental Oceanographic Commission
IRS	Indian Remote-Sensing Satellite
IRSP	Indian Remote-Sensing Satellite—Polar
ISCCP	International Satellite Cloud Climatology Project
ISO	International Standards Organization
ISRO	Indian Space Research Organization
ISY	International Space Year
ITCOP	Interagency Tracking, Communications, and Operations Panel
IVOS	Infrared and Visible Optical Sensors
IWGMGC	Interagency Working Group on Data Management for Global Change
JERS	Japanese Earth Resources Satellite
JPL	Jet Propulsion Laboratory
LAC	Local Area Coverage

LAGEOS	Laser Geodynamics Satellite
Landsat	Land Remote-Sensing Satellite
LGSOWG	Landsat Ground System Operators Working Group
LTWG	Landsat Technical Working Group
MECB	Brazilian Complete Space Mission
MESSR	Multispectral Electronic Self-Scanning Radiometer
Meteosat	Meteorological Satellite
METOP	Meteorological Operational
MOPITT	Measurements of Pollution in the Troposphere
MOS	Marine Observation Satellite
MSG	Meteosat Second Generation
MSR	Microwave Scanning Radiometer
MTPE	Mission to Planet Earth
MWR	Microwave Radiometer
NASA	National Aeronautics and Space Administration
NASDA	National Space Development Agency
NESDIS	National Environmental Satellite, Data, and Information Service
NOAA	National Oceanic and Atmospheric Administration
NS	Network Subgroup
NSC	Norwegian Space Centre
NSCAT	NASA Scatterometer
P _L SG	Passive Microwave Subgroup
PNRA	Program for Antarctic Research South Pole Directory
POEM	Polar-Orbit Earth Observation Mission
POLDER	Polarization and Directionality of the Earth's Reflectances
Radarsat	Radar Satellite
RAE	Royal Aerospace Establishment
SAFISY	Space Agency Forum for the International Space Year
SAR	Synthetic Aperture Radar
SCARAB	Scanner for the Radiation Budget
SeaWiFS	Sea-Viewing Wide Field Sensor
SFCG	Space Frequency Coordination Group
SFDU	Standard Formatted Data Unit
SHARP	Standard Family HRPT Archive Request Product
SIR-C	Spaceborne Imaging Radar-C
SNIP	Space Networks Interoperability Panel
SNSB	Swedish National Space Board
SPOT	Système pour l'Observation de la Terre
SSBUV	Shuttle Solar Backscatter Ultraviolet
STA	Science and Technology Agency
TBD	To Be Determined
TDRSS	Tracking and Data Relay Satellite System
TIROS	Television Infrared Observing Satellite
TM	Thematic Mapper

TOMS	Total Ozone Mapping Spectrometer
TOPEX	Ocean Topography Experiment
TOVS	TIROS Operational Vertical Sounder
TRMM	Tropical Rainfall Measuring Mission
UARS	Upper Atmosphere Research Satellite
U.K.	United Kingdom
U.N.	United Nations
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Program
U.S.	United States
USGS	U.S. Geological Survey
VTIR	Visible and Thermal Infrared Radiometer
WCRP	World Climate Research Program
WGADS	Working Group on Auxiliary Data Sets
WGCV	Working Group on Sensor Calibration and Geophysical Validation
WGD	Working Group on Data
WGSN	Working Group on Space-to-Ground Networks
WMO	World Meteorological Organization
X-SAR	X-Band Synthetic Aperture Radar

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